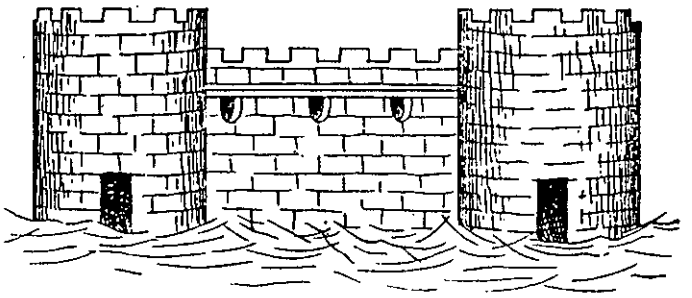
# Bulwark & Bastion

by

Hinds & Fitzgerald



# Bulwark and Bastion:

## A Look at Musket Era Fortification With a Glance at Period Siegecraft

by

James R. Hinds & Edmund Fitzgerald

with

Stone Walls and Iron Guns:
Forts and Their Effectiveness in the Civil War

by

James R. Hinds

eprinted from the Council on Abandoned Military Posts *Periodical* with a new lossary of Technical Terms.

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# Preface

After the invention of cannon a new science of fortification gradually developed to meet the new threat posed by gunpowder. The systems worked out were destined to have a very long useful life. It was not impossible, for example for fortifications constructed in the Sixteenth Century to still resist attacks effectively in the early Nineteenth. Similarly, the system of siegecraft perfected by Sebastien de Vauban in the Seventeenth would still find employment in the Nineteenth. As late as 1883 the U S Army's Chief of Ordnance would authorize republication of a recent article which declared "the general principals which Vauban was the first to grasp, and which his rules embodied, remain as applicable as ever." Any theories which influenced military affairs for such an extended period are surely worth the attention of students of history.

James R. Hinds
April 15, 1981

# Contents

# An Introduction to Fortification in the Musket Period

The construction of fortifications to secure places from attack is a practice almost as old as mankind. Many primitive peoples have learned to erect stockades, earthworks, or walls of one sort or another to protect their dwelling places. The classic civilizations of the Mediterranean protected their cities with massive walls strengthened by towers from which the defenders could deliver flanking fire. During the Middle Ages, barons constructed castles for their strongholds; and, later towns surrounded themselves with strong walls. The invention of gun powder, however, soon changed all this.

In 1453, the Turks breached the centuries old walls of Constantinople with huge, new cannon. Nor was this an isolated incident. King Charles VII of France reduced the English strongholds in his country with guns and Charles VIII invaded Italy, bringing a large train of artillery along to demolish the fortifications of any who attempted to resist. Obviously, old-time fortifications, walls and towers, had become obsolete. Low, semi-circular earthworks, called bulwarks, posted well in advance of the old fortifications, could make the enemy stay beyond effective cannon range of the walls. These bulwarks were strengthened with timber and revetted with brush, and seem to have been developed from the barbican, a kind of outwork to protect a gate. Originally, bulwarks were constructed before the gates, then at intervals all around the walls. However, such outworks were often easy to take by storm. Something new was needed.

During the 16th and 17th centuries, a new system of fortification with massive masonry ramparts and projecting bastions began to emerge. Basically, these bastions were bulwarks constructed closer to and connected with the curtain walls in their rear. Italian engineers led the way. A bastioned fort was erected on the Island of Rhodes as early as 1496. Verona was fortified about 1520. Paciotto constructed a bastioned, pentagonal citadel at Antwerp in 1568. Meanwhile, work was begun on great fortifications to guard the King of Spain's New World possessions.

The new forts' massive ramparts were more resistant to breaching than the castles of old with their high, relatively weak walls. Also, the heavy ramparts provided a more suitable platform for the defenders' artillery. The

projecting bastions enabled the defenders to direct their fire against the flanks of anyone trying to scale the walls between them. The chief weakness of these early forts lay in their relatively exposed masonry and the small size of the bastions.

During the 17th century, the Italian school declined after its adherents became obsessed by geometrical systems that failed to take into consideration either the nature of the ground at the forts' sites or the expense of building.

Meanwhile, in the war-torn Low Countries, Maurice of Nassau (1567-1625) gained fame for his skill at siegecraft and the art of fortification. Menno Van Coehoorn elaborated on his ideas and inspired a new school. The Dutch engineers began by adding broad, water filled ditches, palisades and semicircular or "V" shaped outworks to their old town walls. Later, they experimented with the bastioned system. They constructed large bastions close together, lengthened their faces, shortened their flanks, and added numerous "V" shaped outworks. The Dutch pioneers inspired later engineers to eliminate the flanks of the bastions and develop tenaille and star shaped forts.

During the reign of Louis XIV, leaderships passed to the French. The great military engineer Sebastien le Prestre de Vauban (1633-1707) developed bastioned fortification, and made siegecraft a fine art. His early fortifications were often polygons with bastions at the angles and "V" shaped outworks or ravelins in the intervals. The flanks of his bastions were sometimes straight, and sometimes curved. Vauban occasionally constructed tenaille outworks, which serve to shield the main fortress from fire. Typical of these so called first system forts was Saarlouis, a regular bastioned, pentagonal fortress, constructed in 1680. The main weakness of these forts was that the ravelins were too small to make good artillery positions and afforded little protection against fire to the shoulders of the bastions.

Later, Vauban improved on his early designs in his "second" and "third" system forts. These fortifications had towers constructed at the angles behind detached bastions. In addition, there were large ravelins, some with keeps or inner strongholds and tennaille outworks. The fortification at Belfort and Landau (1684-1688), and New Breisach are examples of the so called second and third system fortifications. Actually, Vauban did not really devise new systems, but continually improved on his work. He always believed that a fort must suit its site.

After Vauban's death, his work was continued by Cormontaigne and other disciples. They improved the protection of the masonry from artillery fire by building lower scarp walls. The Marquis de Montalembert (1714-1780), however, found his inspiration in the work of the Dutch and German school. He preferred polygonal forts with caponiers or covered galleries to deliver the flanking fire instead of bastions. In some cases, he designed forts that had tiers of gun rooms or galleries, with masonry walls exposed to fire. Lazare Carnot, a late 18th Century expert, advocated the use of bastioned

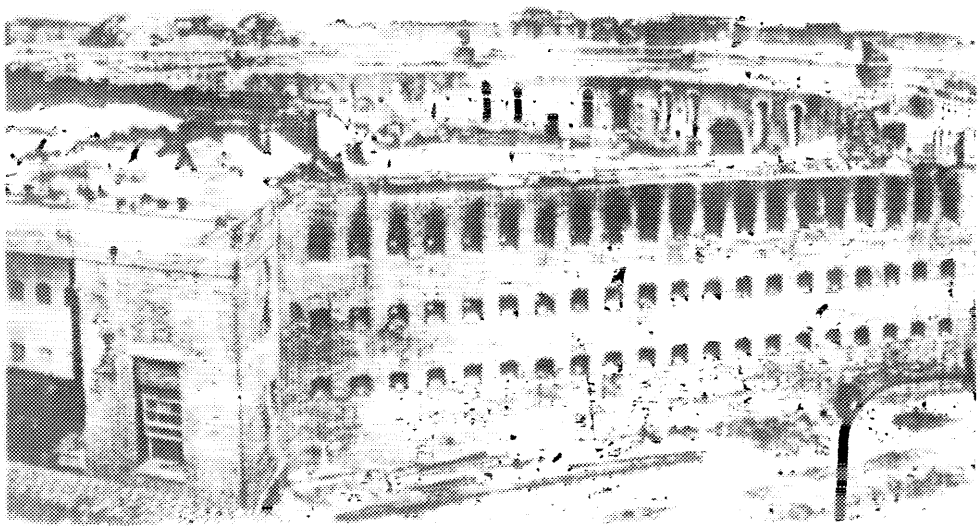
forts on dry, level ground, and tenaille forts with water-filled ditches on irregular ground.

Permanent fortifications were constructed chiefly for such strategic purposes as guarding invasion routes, and securing important ports against sudden attacks. A significant secondary purpose was the protection of the magazines or supply depots that fed the armies. Such were the uses of permanent fortification. Yet there were clearly some situations that required less elaborate works.

Meanwhile, the development of the field fortifications that had given rise to the new permanent works continued along different lines. The great French marshal Maurice de Saxe threw up field works to shelter his infantry at the battle of Fontenoy in 1745. The guns posted in these forts helped repulse the Duke of Cumberland's allied army of English and Dutch troops. The use of earthworks to give defending troops an advantage on the battlefield was fairly common practice throughout the 18th Century. At Saratoga (1777) both the American and British armies erected extensive field fortifications. The Russians also threw up a series of earthworks at Borodino (1812) and the capture of them proved very expensive for the French. Such field fortifications usually took the form of either small unbastioned forts called redoubts (a term sometimes loosely applied to all field works) or else of extensive breastworks forming continuous lines.

In addition to their use in major battles temporary field works also served other important purposes. They helped the garrisons of towns or other important places to hold out until they could be relieved. Here the function of permanent and temporary fortification overlapped somewhat. Yet who could have known in, say 1845, that the City of Washington would need a continuous ring of fortifications some 16 years later? For another example, the outposts that covered the winter encampments of armies frequently fortified the ground they occupied. The works thrown up by besiegers may also be considered a type of temporary works. The advantages of temporary fortifications were obvious. They could be erected when and wherever needed, they cost little to construct and they gave good protection against fire. However, they required very careful maintenance if they were to serve for a prolonged period and they were not as secure against storming as permanent works.

Soon after gaining independence the United States began to construct new seacoast forts, and work continued intermittently on the program until the Civil War. Such writers as Dennis Mahan pointed out that fortifications were especially important to a country which had to rely heavily upon militia for its defense. Fortifications would give the militiamen greater confidence and would also keep down casualties, which was especially important since such soldiers, unlike mercenary professionals, were the heads of households, husbands and fathers. Hence such works would serve an important social as well as a military purpose. Right from the start, the new republic chose to build forts only, rather than construct fortresses or fortified towns. Doubtless



*The citadel at Fort Morgan, Alabama, one of the defenses for Mobile. This was a third system work. Photograph by Army Engineers.*

economy played the chief role in this choice, but it also served to keep civil life more distinct from military affairs.[1] However, during the colonial period there had been a few true fortresses, such as St. Augustine, Louisbourg and San Juan.

The earliest of the new fortifications were generally constructed of earth and timber and were little more than field works on the seacoast. Later brick and stone were used in the construction of revetments, barracks, gatetowers, and powder magazines, mainly to give permanence. For example, the original Fort Moultrie, at Charleston Harbour, South Carolina, belonged to the first period of construction. Fort McHenry, at Baltimore, Maryland, was a late First System, bastioned, pentagonal work, with brick revetments and buildings. The designs of these early forts owed much to the school of Vauban. It would seem that many of the French advisors who helped design these works shared the belief of Louis de Tousard that "after such a reputation as that of Vauban, there remains but one engineer who can be mentioned with any kind of propriety . . . Cormontaigne." After 1800 a new program was started. Second System forts, such as Fort Columbus, a bastioned work on Governor's Island, in New York Harbour, and Fort Wood, a star shaped fortification on Bedloe's Island, were more elaborate.

In addition to bastioned and star shaped works, a number of Second

System forts had semi-round or semi-elliptical faces such as Fort Norfolk, Virginia. There were also a number of round semiround forts constructed wholly of masonry. These varied in size from small Martello towers to major works such as Castle Williams on Governors Island, which mounted eighty guns. These towers generally incorporated one or more tiers of gun rooms or casemates in addition to provision for mounting guns behind the parapets around the top.

Unlike the earlier forts which follow the classical principles laid down by Vauban and his school, are low in silhouette, with their masonry somewhat masked by earthworks, those forts built after 1816 were quite exposed. These Third System forts were designed specifically to deal with wooden battleships. After a few early bastioned designs, the engineers more and more favored simple polygonal outlines. All these works generally have two or three tiers of vaulted gun rooms or bomb proof casemates, in addition to gun positions on the ramparts. The towering masonry walls were exposed to direct fire and relied on their relative thickness to protect the gun crews behind them.

Many examples could be cited. Fort Washington, Maryland, is of a transitional design. Its earthen rampart facing the ravine in its rear provided a measure of protection from land attack on that side and recalled the earlier constructions, but its towering demibastions, with their casemated gun positions overlooking the Potomac River, are typical of Third System forts. Forts Scott, Sumter, Pulaski and Jefferson are good examples of the later works of this period.

# Permanent Fortification in the United States

American musket era permanent fortifications stand along the coasts as an impressive sign of our ancestors' desire to protect important port facilities and the approaches to those facilities. Their massive walls have long drawn the attention of historians and visitors alike. Yet how many have really looked into the purposes of the different features of these works? Without some understanding of the principles that guided their designers and builders we are left with but slight understanding of their real significance and as it were, in a realm of myth and misunderstanding. It may be profitable to look closer at the designs of the old forts.

### The Principles of Fortification

Military engineers generally recognized the fact that, given enough time and resources, an enemy could capture any fortress. The objective of the military engineer then was not so much the construction of an invincible stronghold as defense works of a more modest character.

Forts were expected to be strong enough to withstand any simple open attack on them; and were constructed so as to delay the enemy by forcing him to lay siege to take them.

They were furnished with "easy and secure means of communication for the movement of troops, both within the defenses and to the exterior."[1] A fort without such facilities would have been little more than a rat-trap for its garrison.

Forts were planned so that their guns could fire upon any points outside the defenses but within artillery range. Fort Washington, Maryland, however was constructed in violation of this principle. The hill on which the commandant's house stands provides both an advantageous point on which a besieger could emplace his guns, and a shelter for troops posted behind it.

Forts were provided with suitable shelters to protect the defenders, gun magazines and provisions that would make their defense possible.

Forts were so constructed as to make full use of the natural advantages afforded by the terrain to the defender, as well as to minimize the weaknesses or disadvantages.[2]

### The Principal Features of A Fort Profile and Their Purposes

The *rampart* was an earthen mound or masonry construction on which the

parapet is placed. It gave troops and guns posted there a commanding view over the ground they were to guard by their fire. The *terreplein* was a level platform, sometimes sheltered from direct fire which "affords troops a convenient position for circulation from point to point."[3] The terreplein ran around the top of the rampart. Other features of the rampart included the rampart slope, or more often a parade wall and the ramps which gave access to the terreplein:

The *parapet* was an earth or masonry construction that afforded cover to troops stationed on the rampart's terreplein. The *banquette* was a firing step right behind the parapet, so designed that a soldier standing on it would expose no more than his head and shoulders. Earthen parapets were 20 to 25 feet thick and well adapted to soak up the shock of enemy projectiles. Masonry parapets were thinner, but tended to shatter more easily under the impact of heavy shot.

The *ditch* served as both an obstacle and an earth source for the ramparts and glacis. It was generally about 20 to 30 yards wide. If the ditch were too narrow, it would not be an effective obstacle, if too wide, it would expose the ramparts to fire. Ditches might be wet or dry, that is filled with water or not.

The *scarp* was a masonry wall up to 30 feet high which acted to retain the rampart and made it much more difficult for attacking troops to climb the ramparts and gain entrance to the main work.[4]

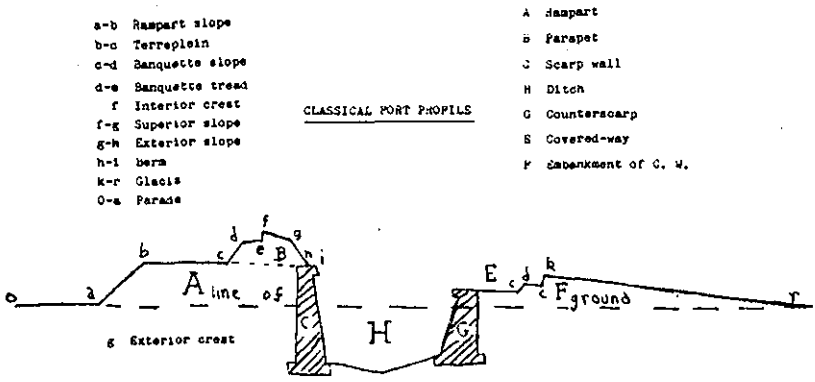
The *counterscarp* was a masonry wall similar to the scarp but across the ditch and opposite to the scarp. It served as a retaining wall for the ditch and as an obstacle to escalade. It helped protect the scarp from fire and also served to screen defenders moving through ditches. Finally, it also afforded "facilities for forming a counterscarp gallery behind it, loop-holed for the defense of the ditch in an open assault."[5] Fort Washington has a somewhat modified gallery of this type, from which fire could also be delivered away from the fort.

The *covered way* was a level area, usually about 12 yards wide located beyond the ditch, and protected from direct fire by an earthen bank formed in the glacis. This allowed defenders to move out around the fort, and to fight from positions forward of the ramparts. Low earthen mounds called *traverses* broke up the covered way to prevent enfilading fire if the attackers broke through at some point.

The *glacis* served to mask the scarp of the fort from direct cannon fire and provided a clear field of fire for troops fighting from the ramparts or covered way.[6]

The profiles of the third system forts and of the demibastions at Fort Washington are higher and vary somewhat from the earlier construction.

> In the casemated batteries for sea-coast defenses, the scarp or mask walls of the chambers for the guns, being exposed to the fire of ships alone, are not covered, as in land fronts, by an earthen mask; these walls being built of sufficient thickness and strength to withstand the fire of the heaviest guns within the range that ships can venture to attack, being less vulnerable than the wooden or iron sides of vessels . . . [in] general use.[7]




The origins of the *casemate* go back centuries. Gun loops were added to castles as early as the last quarter of the fifteenth century. In the time of Henry VIII the English built a casemated fort called Walmer Castle, and other casemated towers were constructed elsewhere in Europe.[8] However, two problems remained. If you raised walls high enough so that guns could be emplaced to fire through embrasures in them, then the walls themselves would be exposed to the fire of enemy guns which could be mounted behind less vulnerable siege works. In addition, cannon in action generated thick smoke which had to be carried off some way.

The Marquis de Vauban, seventeenth century French military engineer, made only limited use of a few casemates in some of his later works. These were situated in low towers shielded behind large detached bastions and were arranged to cover the ditches on either flank. The casemates were not entirely successful because, according to one eighteenth century author, "as soon as they have fired once or twice the smoak will oblige the defenders to leave them, notwithstanding their smoak-holes."[9] Nevertheless, the same writer concedes that there were strong reasons for raising the height and covering over defenses that faced the sea: "those behind them may be fired upon, from the round top of the [ship's] mast, by which the gunners were obliged to abandon their guns, to save themselves by flight and so these forts become of little or no use."[10] To avoid these dangers the engineer was advised to make his rampart nine or ten feet high "and to cover the batteries overhead, which may be done by making an arch over every piece left open behind to let out the smoak."[11] Moreover, he advised that "if there is any slates of sand or rocks, near or within the entrance of a harbour, it will be very proper to build some tower or fort there of several stories well arched so as to be bombproof, in order to place several ranges of guns in them; but as the smoak might be troublesome in the lower stories I would make it open in the middle, that is I would make two concentric walls so that the arches of the roof of the lower

stories might be quite open behind."[12]

Louis de Tousard objected to the construction of casemated masonry works, even on the seacoast. "Almost all the batteries which are usually erected on the seashore," he wrote, "besides their want of elevation, have the fault of being made in masonry." "It is almost impossible," he added, "to perform the service [of the guns] behind such breastworks, because one single shot, striking into the embrasure, if there are any, or the crest of the parapet, will throw a quantity of stone into the battery and do more harm than several grape shot."[13]

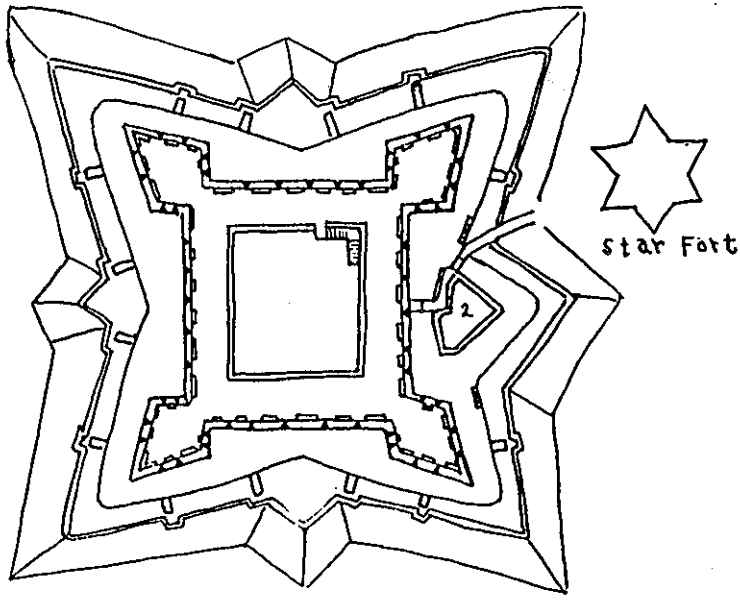
Despite such opinions the ideas of the English specialist John Muller and the Marquis de Montalembert were to prevail, at least in the case of seacoast fortifications. Doubtless either of them would have been skeptical as to the frequency with which naval gunners scored embrasure hits from moving ships. In any case, their ideas evidently contributed to the design of such Second System forts as Castles Williams and Clinton in New York Harbor, and led to the development of such Third System forts as Fort Richmond, New York, and Fort Winfield Scott, San Francisco, to name but two.[14]

### The Enceintes or Traces

Forts were constructed in several different shapes or outlines. These outlines or patterns formed by ramparts and ditches were referred to as enceintes or traces. There were circular forts such as Castles Clinton, Williams, and Fort Norfolk, polygonal works such as Forts Sumter and Pulaski, tenailled forts and star forts, such as Fort Wood, in New York Harbor. There were also bastioned forts such as Forts Adams, Columbus, Independence, McHenry and Monroe. All of these shapes with the exception of some of the circular and polygonal forms, were designed to furnish flanking fire.

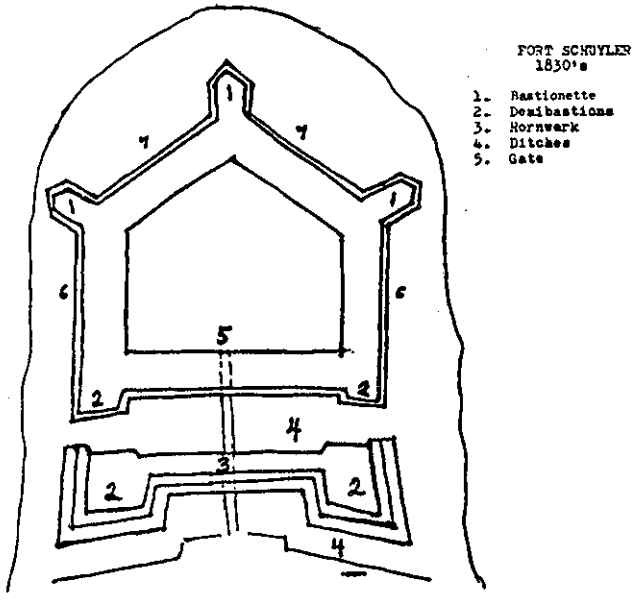
Often forts were laid out on the figure of a square or polygon with a bastion at every angle. If the sides were very long, additional bastions would be traced in between.[15] Originally, bastions were semicircular projections like bulwarks, but by the first decade of the sixteenth century they had become polygons faced with stone.[16] Each bastion had two sides looking outward from the fort and joined in a projecting or salient angle. From the ends of these faces, as they were called, other sides called flanks ran backwards to the basic figure. These flanks formed receding or re-entering angles where they joined the main outline. If an enemy were to attack the rampart running between the bastions, he would find himself under fire not only from the rampart under attack but also from the flanks of the bastions on either side. On the other hand, if he were to attack a bastion, he could be fired upon from the flanks of its neighbors.[17]

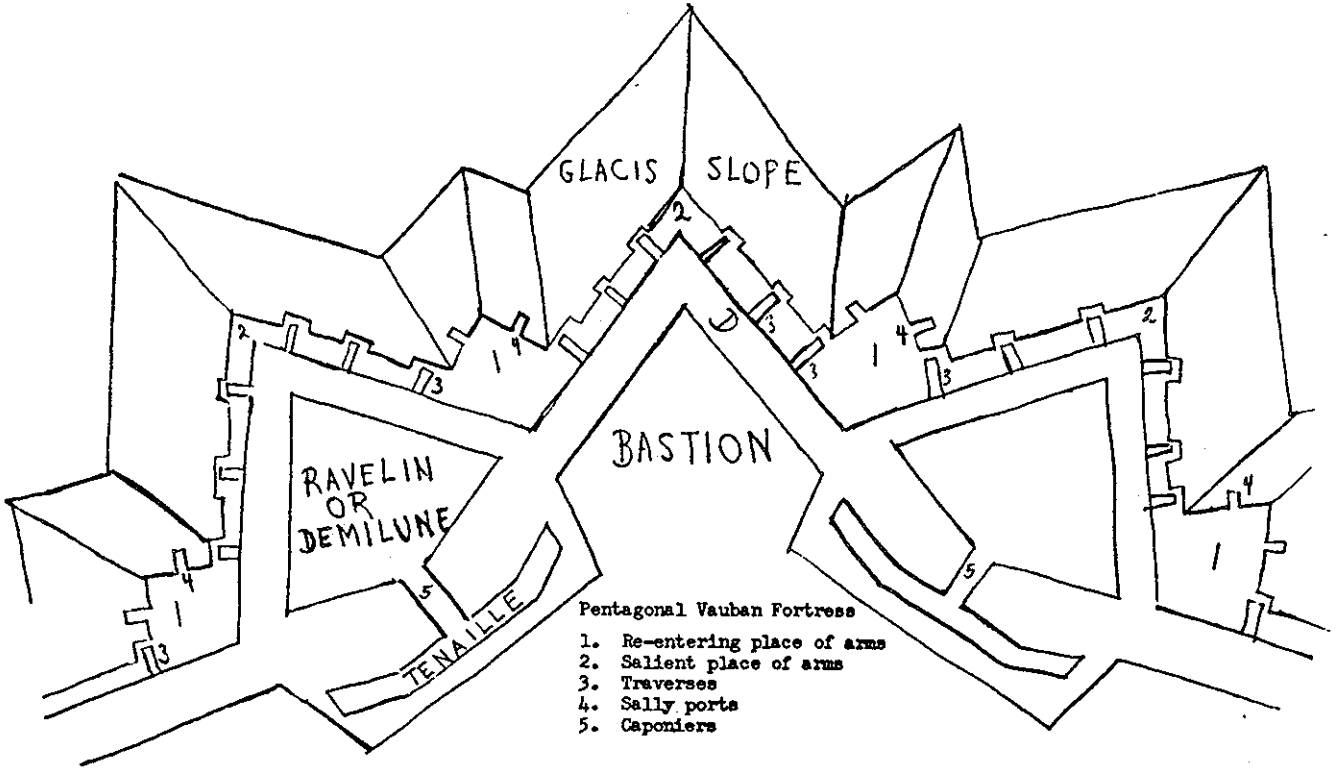
The size of bastioned forts varied. A small square fort with a bastion at each corner might be about 200 yards on a side, measuring from the salient of one bastion to another. The faces of each bastion would then be about 50 yards long. A larger work might be pentagonal with 360 yard sides and




*Small 17th-18th century fort with Ravelin.*

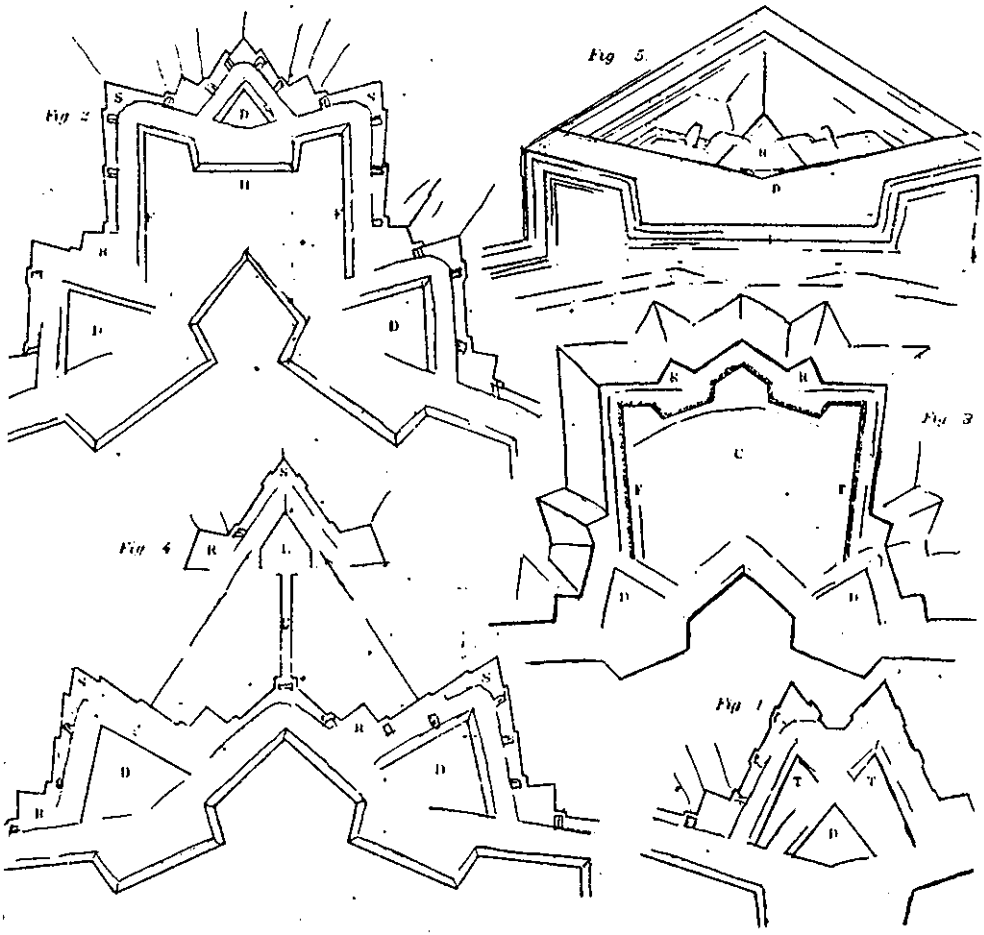
*Sketch of Fort Schuyler, a later development.*



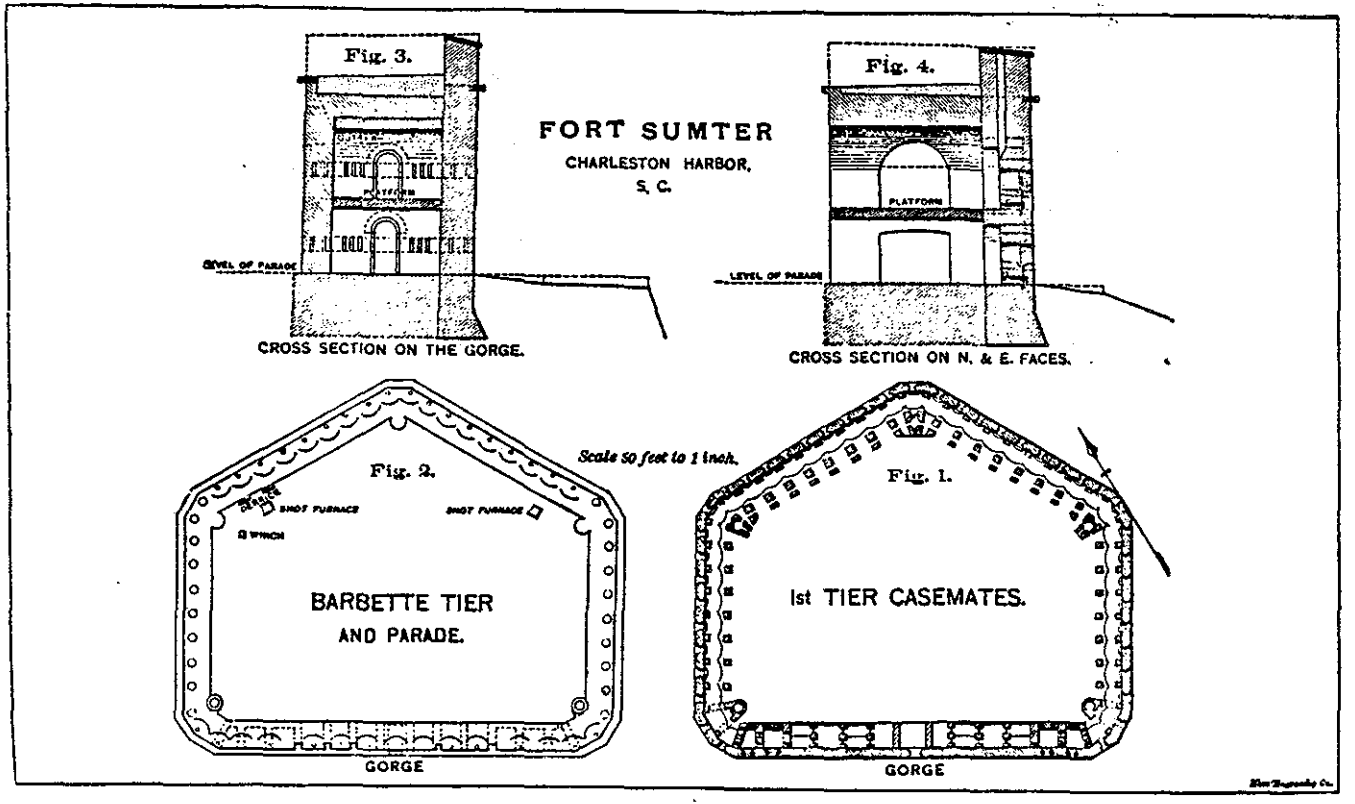



Pentagonal Vauban Fortress

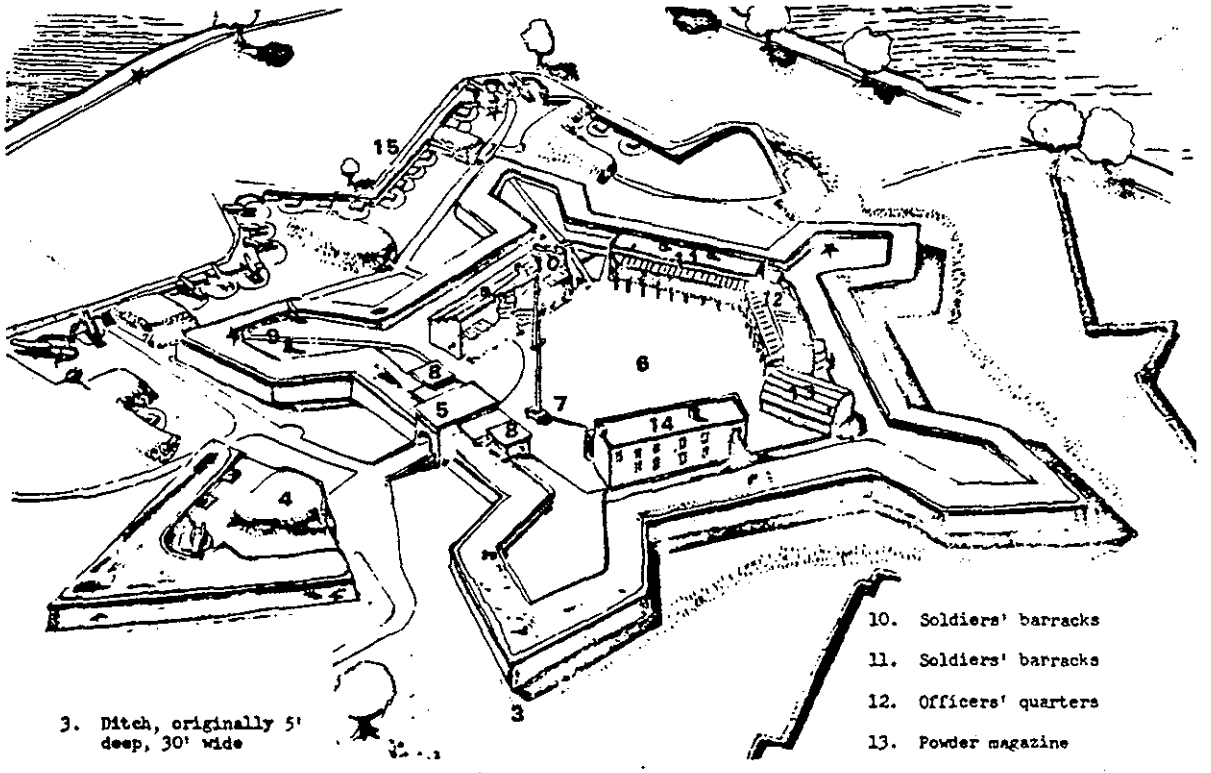
1. Re-entering place of arms
2. Salient place of arms
3. Traverses
4. Sally ports
5. Caponiers



*Secondary fortification structural features: Figure 1, lower right, ravelin (D), with tenaillons (T). Figure 2, upper left, hornwork (H) with ravelins (D), flanks (F), re-entering places of arms (R), salient places of arms (S). From Mahan.* An Elementary Course of Permanent Fortification.




*Fort Sumter was a third system work. From War of The Rebellion, Series I. Volume XXVIII.*




3. Ditch, originally 5' deep, 30' wide
4. Ravelin, built in 1837
5. Main gate
6. Parade
7. Flag staff
8. Guard rooms
9. Bastion
10. Soldiers' barracks
11. Soldiers' barracks
12. Officers' quarters
13. Powder magazine
14. Headquarters building
15. Civil War period water battery

*National Park Service drawing of Fort McHenry, Baltimore.*

bastions with faces twice as long as those of the smaller work. The flanks of bastions needed to be long enough to mount at least two guns, but could be no farther apart than the extreme range of musketry. On irregular ground, for example on a narrow ridge between rivers, the outline of a bastioned fort would have to be tailored to fit.[18]

The cremaillere or indented trace had faces and flanks succeeding each other in regular order. Fort Mifflin at Philadelphia used this trace on one front.[19]

Star and tenailled forts did not have bastions. Instead they had a series of projecting salients each joined directly to its neighbors. Tenailled forts differed from star forts chiefly in that the former's salients were of unequal size. Usually large salients alternated with the small.[20] Such forts were rare in America.

Polygonal trace forts often had no bastions. In Europe these works had casemated caponiers sunk into the ditches to provide flanking fire. These caponiers were semicircular projections reminiscent of the old Italian bastions. Many American forts of this type had no flanking defenses of any kind. Forts Sumter, Carroll and Gorges are good examples. Generally, polygonal forts were planned as four, five or six-sided figures, often with a long side at the rear. Polygonal forts were often sited at isolated points or protected by outworks on the land side.

Round and semiround forts were often also built at places beyond the reach of siege guns. This trace was often used for small batteries for which elaborate flanking arrangements would have been impractical. The enceinte chosen for a fort would naturally depend on the purpose of the work, size of the proposed garrison and the character of the ground.[21]

**Communications**

Already, we have mentioned the need for communications within and without forts. By this, the engineers did not mean so much a mode of sending messages as a way of moving troops of the garrison from one point to another. Communications were constructed in accordance with certain principles.

Communications:

a. Were not to compromise the safety of a fort by providing easy access to attackers, i.e., communications must be secure.

b. Were planned to allow "convenient circulation" of the besieged garrison.

c. Whenever possible, were designed to be useless to an enemy when brought under the defenders' fire.

d. Were so constructed, when possible, as to be protected against fire from any point that the enemy might reach — hence the erection of traverses on the covered way.

e. Were designed so that friendly troops might safely retire from outworks without having their retreat compromised or threatened.

f. Each outwork had to be relatively independent of all routes of communication except its own. Otherwise, the capture of one outwork would

mean the isolation of the rest.[22]

Facilities for communications included ramps for artillery or infantry, stone stairs, about four or six feet wide, posterns and gateways.

Posterns were "arched bomb-proof passageways" under terrepleins and ramparts, leading between the parade and ditch.[23] Usually, the passageway was 12 feet wide and terminated some six feet above the bottom of the ditch, which could be reached by lowering a wooden ramp. Generally, these passageways were also barred by strong doors at either end and sometimes by one in the middle, as an additional precaution against surprise.

Gateways were larger entrances that would allow the passage of carriages or supply wagons. They were arched over when possible, and provided with flanking guardrooms. Sometimes security was provided by a drawbridge, a heavy gate or by a metal latticework portcullis that could be dropped to bar the passage. Occasionally, the guardrooms were furnished with loopholes covering the passageway as well. Small loopholed tambours or walls were sometimes constructed on the far side of the ditch, directly before the gate, if it were not protected by a ravelin or other outwork.[24]

The caponier or double caponier served as a means of communication through the ditch to the gorge of the ravelin. This should not be confused with the casemated caponier. Instead it consisted of a simple passageway between two low parapets which sloped in a glacis on the side away from the passage. A banquet or firing step ran along each side of the passage so troops could sweep the ditch on either side with fire.[25]

### Secondary Fortifications

Secondary fortifications included detached works, advanced works, outworks and redoubts plus interior works. Detached works were constructed to guard important places such as river crossings that were beyond the range of fortress guns. A tete-de-pont was a fort that guarded the head of a bridge. Advanced works were, like detached forts, entirely independent fortifications, but were within cannon range of the main work.

An outwork was a secondary fortification covered by the fire of the main fort and so constructed as to be entirely dependent upon it. In other words, it was one sided fortification useless to the enemy if he captured it and untenable if the main fort fell.[26] The rule was that those works "which are most retired should command those in advance."[27]

We have already mentioned the use of the covered way positions as outworks. The salient angles in the covered way were called salient places of arms. From these places the defenders could sweep the glacis with their fire. The re-entering angles formed the re-entering places of arms. Sortie parties assembled there could pass out onto the glacis through sally ports cut into the glacis embankment.[28]

Other usual outworks were tenailles, hornworks, demilunes or ravelins. Counterguards, tenaillions[29] and other forms were less usual. Most typical of the outworks of American forts was the demilune or ravelin. Examples or

remains of these may be seen at Forts McHenry, Pulaski and Washington. There is even a small one at Castillo de San Marcos in St. Augustine, Florida.[30] Ravelins were usually situated beyond the fort's main ditch, and were not joined to the main work. The ravelin's rampart and smaller ditches formed a giant "V," often covering the main gate.

Hornworks and crownworks were built at some American forts. These outworks covered entrances and gateways or enclosed structures which might compromise the safety of a fort. Hornworks consisted of two connected demibastions with long, nearly parallel wings running backwards toward the main work. Crownworks were similar but had an ordinary bastion in the center, between the demibastions. Usually other outworks or portions of the main work provided flank protection for the wings.[31] A hornwork guarded the land approach to Fort Schuyler, New York, while a crownwork was used for the same purpose at Fort Adams, near Newport, Rhode Island.[32]

The tenaille was a low work erected in the ditch between bastions, so as to mask the base of the scarp wall from fire and to protect postern gates from observation or fire. It usually took the form of two wings joined in the center or of a straight center section with two short wings, well revetted with masonry.[33] Surviving examples may be seen at Fort Adams.[34]

Redoubts were either the interior works of outworks, detached ravelin-like works beyond the glacis or small square advanced works sited to close some approach to the main fortification. In the first case the redoubt served as a keep into which the defenders could retire, in the second as an outwork of the outworks and in the third as an independent work which could be supported from the main work.[35]

Secondary fortifications also included interior works of several kinds designed to prolong resistance after the fall of the work in which they were built. Sometimes bastions within bastions called caveliers were constructed. Sometimes a fort's garrison would throw a retrenchment across the gorge of a bastion that had been breached. Some fortresses also included citadels or independent interior works that could hold out after the main work fell.[36]

Secondary fortifications were used to delay the capture of the principal work by siege since they were often placed so that they had to be taken first. They guarded important ground that could not be included in the enceinte and they provided added protection for entrances. Sometimes they held out after the principal works were taken.[37]

American permanent fortifications were based largely on European theory and practice but were generally simpler and smaller with fewer outworks. The United States did not attempt to surround whole cities with a continuous enceinte in peacetime, as some European powers did. Most of its permanent works assumed the character of harbor defenses. When this country did have to fortify entire cities it turned to field works, a cheaper if less durable defense.[38]

## *FOOTNOTES*

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8. Sidney Toy, *A History of Fortification From 3000 B.C. to A.D. 1700* (2nd Ed., London: Heinemann, 1966), pp. 236-251.
9. John Muller, *A Treatise Containing the Elementary Part of Fortification, Regular and Irregular* (London: 1746; Ottawa, Ontario: Museum Restoration Service, 1968), p. 86.
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16. Toy, *A History of Fortification*, pp. 240, 243; F. L. Taylor, *The Art of War in Italy 1494-1529* "The West Point Military Library," Ed. T. E. Gries (1921; New York, N.H.: Greenwood Press, 1793), pp. 142-143, 153-154.
17. Muller, *A Treatise . . . of Fortification*, pp. 20-22, 24-26, 68-70; *Encyclopeadia Britannica* 11th Ed., Vol. X, pp. 685-686.
18. Muller, *A Treatise . . . of Fortification*, pp. 28, 163-164, 196-200; Mahan, *An Elementary Course of Permanent Fortification*, pp. 29-30.
19. *Encyclopedia Britannica* 11th ed., Vol. X, p. 686; Lewis, *Seacoast Fortification of The United States*, p. 23 (Photo)
20. Mahan, *An Elementary Course of Permanent Fortification*, p. 19; *Encyclopeadia Britannica* 11th Ed., Vol. X, pp.,686, 691-692.
21. *Ibid.*, pp. 692-693; Lewis, *Seacoast Fortification of The United States*, pp. 34-35, 40, 51, 54-55. (Photos), Mahan, *An Elementary Course of Permanent Fortification*, pp. 144-145, noted:

    "The tower without earthen masks can only be used with advantage in positions where it will not be exposed to being breached from a distance; and is a very good auxiliary in sea-coast defence, for points where the object is solely to prevent an enemy's vessels from making use of a safe anchorage on the coast."

22. Mahan, *An Elementary Course of Permanent Fortification*, pp. 14-15.
23. *Ibid.*, p. 15.
24. *Ibid.*, pp. 15-17.
25. *Ibid.*, pp. 34, 52-53.
26. *Ibid.*, pp. 20-25.
27. *Ibid.*, p. 20.
28. *Ibid.*, pp. 21, 69-73; Muller, *A Treatise . . . of Fortification*, pp. 41-43.
29. Mahan, *An Elementary Course of Permanent Fortification*, pp. 22-23; Muller, *A Treatise . . . of Fortification*, pp. 31-51.
30. Lewis, *Seacoast Fortifications of The United States*, pp. 16, 24, 51, 91 (Photos).
31. Mahan, *An Elementary Course of Permanent Fortification*, pp. 22-23; Muller, *A Treatise . . . of Fortification*, pp. 31-41.
32. Lewis, *Seacoast Fortifications of The United States*, p. 49 (Photo).
33. Mahan, *An Elementary Course of Permanent Fortification*, p. 22.
34. Lewis, *Seacoast Fortifications of The United States*, p. 49 (Photo).
35. Muller, *A Treatise . . . of Fortification*, pp. 32, 44, 229.
36. Mahan, *An Elementary Course of Permanent Fortification*, pp. 23-24.
37. *Ibid.*, pp. 20-25.
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# Fortifications in the Field and on the Frontier

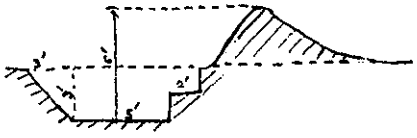
During the musket era field fortifications offered a means of temporarily fortifying towns and cities, a way of strengthening positions in the field or of protecting encampments. The possibility of throwing up field works whenever and wherever they were needed at a low initial cost made them an important type of fortification. No one doubted that they gave fine protection from fire. From the Revolution onward they played an important part in American military history, finding great use in the Civil War when whole cities were protected with field works. No survey of musket era fortification would be complete without some examination of the principles which governed their construction. Nor would a survey be complete without glancing however briefly at the specialized Indian frontiers. It is field works, however, that command our first attention.

### Principles of Field Fortification

*Field fortifications were generally constructed to give security where time* and expense would not allow the erection of permanent works. Armies frequently constructed field works to guard places of concentration or encampment, a city or town against a sudden attack by stronger enemy forces. Sometimes field fortifications were erected on the battlefield, when time permitted. Siege lines were a special type of offensive field works. These we will review later.

Field works served to shelter their garrisons from enemy fire, and were in themselves obstacles to his advance. The fortification generally consisted of a *covering mass or embankment, the parapet, designed to intercept enemy* missiles, to enable the defenders to use their own weapons efficiently and to be an obstacle, and a ditch which was both an earth source and an obstacle. Field fortifications were constructed on much the same principles as permanent works, but also they had some rules particularly applicable to themselves.

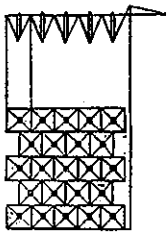
Flanking field works were not supposed to be beyond effective range of *the works flanked, i.e., "never out of the effective range of musketry."*[1] Before the Civil War period this had meant within about 160 yards; but the



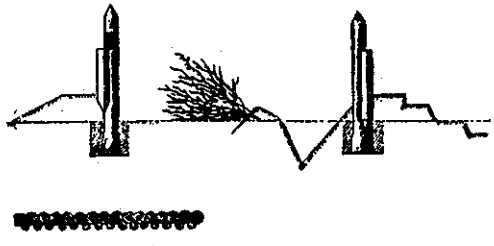
Breast work

caltrop or crow's foot

Chevaux-de-frise



Trous-de-loup



Stockades + abatis

***Fortification definitions adapted from Scott's Military Dictionary.***

rifle musket was effective at longer ranger.

The angles of defense (the angle between a flank and the opposite face) were supposed to be right angles. The soldiers' musketry was most effective when delivered against targets directly in front of them. Oblique fire was limited by the danger that it posed to friendly troops. For these reasons the defenders in a salient had a sector without effective fire directly in front of their projecting angle. This dead area could be covered efficiently from the opposite flank only if the angle were such that the defenders could cover all the ground without endangering their own comrades.[3]

The salient angles of field works were to be as obtuse as possible, in order to make frontal fire more efficient. A salient with an angle of less than

sixty degrees would have been too weak to withstand the ravages of the weather even for a short while. Furthermore, its small interior space would have left no room for maneuver. As we already have said, there would also have been too large a sector without fire before the salient.

Field fortifications needed strong profiles (i.e. steep slopes). The steeper the grades the enemy would have to ascend, the slower his advance would be and the longer he would be under fire. Also, the effort he expended to cross the obstacles left him less able to meet the defender in hand to hand combat.

Large earthwork forts needed facilities for sorties or sallies, sudden attacks on the enemy. The storming party usually would consist of a column of attack, a pioneer or sapper, (engineer) detachment to clear away obstacles and a reserve force. If the defenders could dash out and charge the attacker's flank at the very moment he was trying to climb into the work he would be at a serious disadvantage. Smaller garrisons preferred to stay behind their defenses and avoid all possibility of fighting on equal terms.

A determined defense was necessary to cost the enemy as heavily as possible. If the defenders retired from their first position when the enemy entered the ditch they would lose all the advantages of the work except protection against fire. On the other hand if they waited until the enemy ascended the parapet they would have no time to fall back into their second position. The answer was to drive the enemy back with the bayonet.

A strong reserve was to be held in the rear, ready to charge the enemy and drive him out whenever and wherever he broke into the fortification. They also could cover the retreat of troops forced back from the parapet.[4]

The ditches of field works were to be flanked wherever possible since enfilading and cross fire were very effective. Such flanking dispositions were the very soul of every good defense plan.

Each field work was sited in relation to the others in the system, as well as in regard to the obstacle the fort itself presented the enemy. Thus works that had no flanking arrangements of their own, such as redoubts, for example, might still enjoy the protection having flanking fire.[5]

The size and outline of a field work depended on the number of men that would be available for its defense (as well as its construction). Some types of entrenchment required more defenders than others.

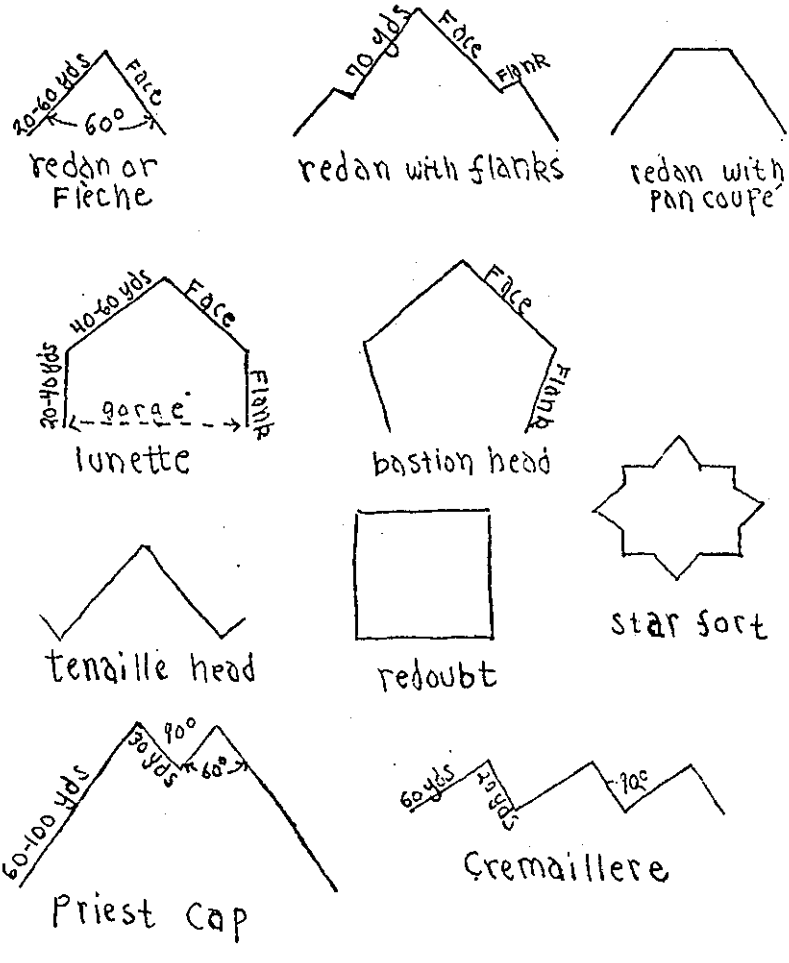
The ground over which the attacker had to pass in order to reach the forts was supposed to be commanded by fire from both the front and flanks, as much as possible. Thus, outworks or rifle trenches were often used to cover defiles through which an enemy might otherwise pass safe from hostile fire.

### Field Work Profiles

The profiles of field fortifications varied considerably from those of permanent works. Field works were constructed of such materials as were readily available. In practice this usually meant earth. The parapets of field fortifications varied from 4 to 12 feet in height[6] according to the nature of the

ground; in the case of Washington, D.C.'s Civil War defenses, from 7 to 9 feet.[7] The parapets of works subject to field artillery fire alone were usually some 8 to 12 feet thick. Otherwise, if subject to naval or siege artillery fire, they were from 18 to 20 feet thick. The unsupported portions of the parapet had to be given gentle slopes to withstand erosion by the weather and minimize the effect of the enemy's shot.[8] For example, the exterior slope had a base equal to its height and thus formed an angle of about 45 degrees. The superior slope (top) receded very gently toward the ditch so as to allow the defenders to use their weapons effectively from a well protected position.

***Traces: ground plans for various types of defense works.***



The interior or inside slope had to be almost vertical so that the defenders could easily lean against it to fire, so revetments had to be employed. These revetments were made of turf, planks, or upright posts, anchored into the parapet and joined by a horizontal timber across the top.[9]

Field works were provided with the usual banquettes and earthen platform bases and ramps for artillery. Wooden planks or hewn timber platforms were laid over the earthen bases. Guns could be mounted either en barbette (to fire over the parapets), or else at embrasures.

Embrasures were cuts through the parapets that flared outward at an angle (up to about 48 degrees) to allow guns firing through them to traverse from side to side. Generally, guns mounted at embrasures were better protected than barbette guns, but did not have as great a field of fire. In field fortifications, the cheeks or sides of these embrasures were generally revetted with turf-filled, open-ended baskets called gabions. This kept the guns from blowing away their own parapets every time they fired.[10]

The ditches of field works presented less of an obstacle than those of permanent fortifications that had nearly vertical scarp and counterscarp walls, although in rare cases the ditches of field works were revetted in the same way as the parapet's interior slope. Generally, the scarps and counterscarps were left as simple earthen slopes. Usually a berm or ledge 18 inches to 3 feet wide was left between the base of the parapet and top of the ditch. This was supposed to help prevent the erosion of the parapet. In the case of the Washington defenses, however, this was often omitted. Instead, the Civil War fort simply had a uniform slope of 45 degrees from the exterior crest to the foot of the scarp.[11]

The covered way was not usually employed in field fortification profiles but there was sometimes a banquette across the ditch from the parapet. Such a banquette may still be seen at Fort Foote on the Potomac below Washington, D.C.

The glacis of field fortifications was usually furnished with obstacles of one sort or another. For example, an abatis could be made of tree tops 16 to 20 feet long, laid in a depression (with branches pointing away from the fort). Care always had to be taken to keep the abatis protected from artillery fire. Other obstacles that were sometimes used were the chevaux-de-frise, caltrops (crow's feet) and trous-de-loup [See illustrations].

Interior structures in field fortifications included stout log, bomb-proof shelters and magazines to keep the men and their ammunition safe from artillery fire. The earthen covering on these buildings was up to 10 feet thick. Sometimes, the bombproofs and magazines were constructed to partially close the gorges or throats of bastions and thus serve as secondary lines of resistance. In these cases they were usually furnished with banquettes and may be thought of as traverses.[12]

### Field Fortification Traces

There were three main types of traces for field fortifications. The first

class consisted of works open at the gorge or rear. These include the redan, the lunette or bastion head, and the priest-cap or swallowtail. Works of the second class were enclosed all around and include the redoubt, the star and the bastioned fort. The third type of works consisted of continuous lines, or lines at intervals. For example, lines of redans, lines of tenailles, lines 'a la cremaillere or indented lines, and bastioned lines.

The redan of fleche was perhaps the simplest field work. It consisted of two sides, each 30 to 60 yards long, joined to form a salient angle. Sometimes it had the point of the angle cut off to form a short face or pancoupe. This reduced the sector without fire. Since this type of entrenchment was open at the gorge or rear, that side had to have protection, either from the nature of the ground or else be guarded by supporting works. However, since it was open in the rear it had little value to the enemy once he captured it.

The lunette or bastion head had two faces and two flanks. It shared most of the advantages and disadvantages of the redan except that since it had flanks it could defend better against attack from that direction. The faces were usually 40 to 60 yards long, the flanks 20 to 40 yards long.

The priest-cap or swallowtail, was constructed in a similar way to the redan, but had two salient angles instead of one. Thus you might say that it had two flanks and two short faces. It resembled a bishop's mitre in form, hence the name priest-cap. The flanks were 60 to 100 yards long, the faces, 30 yards long. Troops stationed along the two faces could cover each other's sectors without fire. Because it had an open gorge the priest-cap was rarely used as a detached work, but was combined with other fortification to secure the advantages of flank and cross fire.

Redoubts were enclosed works without re-entering angles. Sometimes, on a hill their outlines would simply follow the contour of the hill's summit. However, usually they were square or pentagonal in form, and this was especially true where the site was level. As a rule the sides of a square redoubt were never supposed to be under 50 feet long.[13] Among the surviving Civil War forts around Washington, Forts Davis, Dupont and Mahan were all originally planned as redoubts. Later Fort Mahan seems to have been converted into a bastioned work.[14] Most detached works were redoubts or bastioned forts. Redoubts were easy to build and when combined in groups they could have the protection of a mutually supporting cross fire. On the other hand, redoubts also had some disadvantages. The faces of these works could sometimes be enfiladed. There was no real flanking defense for the ditches and there was a considerable area in front of each salient that was without direct fire. In order to counteract these defects, engineers tried to align the works to make them as difficult as possible to enfilade, and to plant obstacles that would make it hard to approach the salients.[15]

The star fort was a polygonal enclosure with both salient and re-entering angles. Such forts provided for partial flanking fire, but had dead spaces before the re-entering angles as well as sectors without fire in front of the salients. Star forts of a given size had less interior space than a redoubt of

the same outside dimensions, but needed more men to defend. Finally, they were more work to erect. Consequently, such forts were less commonly built, but when they were, the salients were not to be less than 60 degrees and the faces, from 30 to 60 yards.

The bastioned fort was the best type of field fortification but it was generally suitable only for major works. The ditches of a bastioned fort were well flanked by fire (if constructed properly) and each bastion covered the other's sector without fire. Bastioned forts were supposed to be 125 to 250 yards long on each side. The main drawback to bastioned forts was the labor it took to construct one. Mahan regarded works with demibastions as being little superior to a redoubt and too much work to build.[16] Forts Foote and Ward are two surviving examples of bastioned field works in the Washington, D.C. area.

There were two types of lines, lines at intervals and continuous lines. Lines at intervals were a series of two or more rows of detached works, mutually supporting each other, but also capable of resisting attack individually. Usually the first line would consist of simple forts open at the gorge, and the rear lines, of redoubts or bastioned forts. These were placed, in conformity with the ground, to protect the advanced position with flanking fire. In other words, usually they covered the intervals in the first line, checkerboard fashion.

Military engineers sometimes connected important redoubts or forts with continuous lines of parapet and ditch. Such lines might have a number of traces. For example, you could form such a line by connecting redans together. If the redans were of unequal size, first a large one, then a small one in alternating order, it was called a line of tenailles. There were also indented lines and lines of bastions.[17]

### Frontier Forts

Frontier fortifications east of the Mississippi tended to be regressive in character. Since the Indians did not have cannon, as a rule earthworks were not usually needed. However, small badly outnumbered garrisons needed high walls to guard against escalades, attacks by climbing warriors. Where timber was plentiful the troops usually erected stockades to form the curtain between buildings. Block houses at the angles provided flanking fire.

In 1765 one writer set out his ideas on the design and construction of frontier forts:[18]

> As we have not to guard here against cannon, the system of European fortifications may be laid aside, as expensive, and not answering the purpose. Forts against Indians, being commonly remote from our settlements, require a great deal of room to lodge a sufficient quantity of stores and provisions, and at the same time ought to be defensible with one half their compleat garrisons, in case of detachments or convoys.
>
> A square or pentagon with a block-house of brick or stone [to reduce maintenance costs] at every angle, joined by a wall flanked by the block-houses would be the best defense against such enemies. A ditch from

seven to eight feet deep might be added, with loop holes in the cellars of the block-houses six feet from the ground, to defend the ditch.

Along the inside of the curtains the traders might build houses and stores, covered as well as the block-houses with tiles, or slate, to guard against fire arrows. There will remain a spacious area for free air and use, in which as well as in the ditch, gardens might be made and wells dug.

The powder magazines might be placed in the center, keeping only a small quantity of cartridges in each block-house. . . .

Most frontier forts followed this general plan, but only at a few places such as Fort Snelling, Minnesota, did troops construct stone defenses.[19] In most areas east of the Mississippi they used wood, prefering easy construction to durability. In the southeastern United States one type of picket work was popular in the 1830s:[20]

> The pickets are made by spliting pine logs about eighteen feet in length into two parts, and driving them upright and firmly into the ground close together, with the flat side inwards; these are braced together by a strip of boards nailed on the inside. The tops are sharpened and holes are cut seven or eight feet from the ground for fire arms. A range of benches extends around the [inside of] the work three feet high from which the fire is delivered.

In the west adobe was often more readily available than timber. Fort Laramie was a good example of this type of work:[21]

> The little fort is built of bricks dried in the sun, and externally is of an oblong form, with bastions of clay in the form of ordinary blockhouses at two of the corners. The walls are about fifteen feet high, and surmounted by slender palisade. The roofs of the apartments within, which are built close against the walls, serve the purpose of a banquette. Within the fort is divided by a partition; on one side is the square area surrounded by the storerooms, offices and apartments . . ., on the other corral . . ., encompassed by high clay walls . . . The main entrance has two gates with an arched passage intervening.

This school of architecture seems to have combined borrowings from the timber forts and the Spanish *presidio*.[22] Many late nineteenth century frontier posts were not fortified. Because of the increased firepower of small arms it was often enough a simple arrangement with the buildings in a rectangle around the parade ground.

Frontier and field fortifications provided an important means of defense.

## *FOOTNOTES*

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2. Dennis H. Mahan, *A Complete Treatise on Field Fortification, with The*

*General Outlines of The Principles Regulating the Arrangement, the Attack, and the Defense of Permanent Works.* "The West Point Military Library," Ed. T. E. Gries. (1836); (New York, Greenwood Press, 1968), p.10.

3. *Ibid.*, pp. 6, 7, 10.
4. *Ibid.*, pp. 1-16.
5. Scott, *Military Dictionary*, pp. 298-299.
6. *Ibid.*, p. 299.
7. John G. Bernard, *A Report On The Defenses of Washington To The Chief of Engineers, U.S. Army* (Washington, GPO, 1871), p. 63.
8. Scott, *Military Dictionary*, p. 284.
9. Bernard, *A Report On The Defenses of Washington*, pp. 63-65.
10. *Ibid.*, p. 65. Light artillery was often mounted on barbette platforms in the bastions of forts. If the enemy's counter — battery fire became too intense the light pieces could be drawn back from the exposed positions.
11. *Ibid.* The berm was a weak point in field fortifications since it gave an enemy trying to scale the parapet a foothold and a place to rest before attempting to climb into the fort. Mahan, *A Complete Treatise on Field Fortification*, pp. 32-33.
12. Bernard, *A Report On The Defenses of Washington*, pp. 65-68.
13. Mahan, *A Complete Treatise on Field Fortification*, pp. 17-27.
14. Charles H. McCormick, *General Background Forts Mahan, Chaplin, Dupont, Davis* (Roslyn, Va., Division of History, Office of Archaeology and Historic Preservation, N.P.S., July 15, 1967).
15. Mahan, *A Complete Treatise on Field Fortification*, pp. 17-27.
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17. Scott, *Military Dictionary*, p. 298.
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19. Herbert M. Hart, *Old Forts of The Northwest* (Seattle, Superior Publishing Co., 1963), pp. 14-16.
20. [Woodborne Potter], *The War in Florida; Being an Exposition of Its Causes and An Accurate History of The Campaigns of Generals Clinch, and Scott by A Late Staff Officer* (Baltimore, Lewis & Coleman, 1836, reprint, Ann Arbor, University Microfilms, 1966), p. 98.
21. Francis Parkman, *The Oregon Trail: Sketches of Prairie and Rocky Mountain Life* "The Lake English Classics," Ed. Wm. MacDonald (New York, N.Y., Scott, Foreman & Co., 1911), p. 124.
22. Sidney B. Brinkerhoff and Odie B. Faulk, *Lancers for The King: A Study of The Frontier Military System of Northern New Spain, with A Translation of The Royal Regulations of 1772* (Phoenix, Ariz., Arizona Historical Foundation, 1965), p. 62 reproducing *Reglamento e instruccion para los presidios que han de formar en la linea de frontera de la Nueva Espana, resuelto por el Rey Nuestro Senor en cedula de 10 de Setiembre de 1772: "se haga con arreglo al nuevo plan, se ha de formar primero el cuadro de tapias comunes de adobes, y los dos pequenos baluartes en sus anglos y despues levantar en lo interior la capilla, cuerpo de guardia, casa de capitan, oficiales, capellan y habitaciones de los soldados e indios."*

# Siegecraft

The ancients displayed great skill and ingenuity in developing ways to capture fortified places, and most of them were still employed during medieval times. Medieval men also developed the early guns that helped end their own era. Siege techniques advanced steadily during the 15th, 16th, and 17th Centuries. We read that the English at the Siege of Rouen in 1418 "dug deep galleries of communication from one quarter to another, which completely sheltered those in them from cannon and other warlike machines."[1] Some years later at the Siege of Harfleur, "sixteen large bombards were pointed against the walls . . .; deep trenches of communication were formed" and "covered trenches carried to the very walls."[2] Systematic zig zag approach trenches were tried as early as the siege of Padua in 1513.[3] Yet as late as 1670 gunners could still debate whether the best methods of attacking a fortress were by breaching one of its bastions or its curtain. Some believed it would be too easy to seal off a breached bastion while other pointed out that an attack against a breach in the curtain would have to pass through fire from the adjacent bastions.[4] A hundred years later such a question could no longer be raised, so great was the influence of Sebastien Le Preste de Vauban.

This French engineer finally systematized siege methods for dealing with the new bastioned forts of the age of gunpowder. In 1673 he captured the stronghold of Maastrich in just 13 days using his new system. In fact, it would be correct to say that it was more in siegecraft than in fortification that he made his original contribution. Since his ideas were destined to be powerful and enduring they are worth considering in detail.

Normally, the besieger needed at least a five to one superiority in manpower and a two to one advantage in guns in order to take a strong fortress. This did not include the howitzers and mortars which would also be needed.[5] Several options were open to the attacker.

If a fortification were weakly held, a commander might prefer a surprise or direct attack as less costly and time consuming than a regular siege. Usually, the assault force would be equipped with ladders for this purpose. Generally, such a force consisted of three elements: an advance party or forlorn hope, usually volunteers, grenadiers or sappers; a column of attack, of greater strength; and a stronger reserve. Such an attack was called an escalade or insult. Direct attacks that failed could prove quite costly.[6]

If a fort were too strong to take by storm, then a siege might be the best method of reducing it. First of all the attacker invested or surrounded it. In order to prevent relief from reaching the besieged, the attacker would station an army of observation, frequently strong in cavalry, in a position between the

interior of the enemy's country and the besieging forces. It was vital to cut off all supplies and reinforcements.

After the initial stage of investment the attacker began his preparations for the next phase. Siege guns were brought up and formed into a large artillery park. Troops not required for guard or construction duties were sent out to cut timber or gather brush for the facines and gabions used in the revetment of siege works.

Once he had completed his investment the attacker had to consider where to begin his approaches to the fort. Usually he chose a convenient area located not far from his base camp. Generally he would avoid flooded, marshy or rocky ground that would make construction very difficult. Often he would choose some weak area in the fort's defense as a suitable place to attack and sometimes he might begin approaches from several directions at once if he had enough men.[7]

About 600 yards from the work and beyond effective grape or cannister range, the attacker constructed a trench before which he situated his batteries. This line formed the first parallel. Sometimes one battery was larger than the rest and this was termed the royal or grand battery. A force of about a 120 to a 140 men could, according to Vauban, construct a battery for four guns in four days.[8] Such batteries resembled other field works in that they consisted of revetted earthen parapets pierced by gun embrasures. The parapets usually had to be from 18 to 20 feet thick and 7 feet high to withstand the fire of heavy garrison guns. Often engineers added 10 or 12 foot thick epaulements or flanks to the batteries for additional protection. Behind each battery the besiegers built a magazine big enough to hold a day's supply of ammunition. Trenches linked each battery to the parallel. Sometimes, however, there were no ditches and usually these positions were open at the rear. Mortar batteries differed because they usually had no embrasures. Instead, the bombardiers planted aiming stakes on the interior crest of their parapet. The important thing was to be sure the heavy mortars had a really solid platform under them. Little Coehoorn mortars could be put anywhere in the trenches as long as they were in range of their targets.[9] During the 19th Century a bank-protected road was sometimes constructed in lieu of a trench, for the first parallel.[10]

Next the attacker began pushing saps, as these trenches were called, toward salient or projecting angles of the fort. At the head of each sap a detachment of six sappers and two infantrymen dug closer to the fort, pushing a large, brush-filled gabion called a sap roller in front of them for protection. They zigged and zagged as they advanced so that the defenders could not rake their trench with fire. When not harrassed that way they could gain up to a hundred and forty yards in a day.[11]

About midway to the fort they began to open a trench on either side of the sap. Once darkness fell new batteries were begun along the line of this second parallel and guns soon were brought forward to the new position. Now

that they were much closer the cannoneers could possibly dismount many of the fort's guns or at least drive the gunners from their places. Whenever possible the besieger had sited his batteries to enfilade the faces of the fort. Guns directed their fire against the defender's guns and traverses, howitzers shelled the covered ways and mortars bombarded the rest of the work. Normally it would not have been possible to breach the walls of a well-constructed fort at this distance since they would be masked by the glacis slope.[12]

However, if an attacker were besieging a seacoast front not designed to resist land attack, the defenders would be in immediate danger.[13] The attacker's guns would not have serious trouble beginning a breach at this distance even in the 18th Century. In fact, the besieger could have begun his breach at three times this range with the ponderous Columbiads and rifled cannon of the 1860s. Usually, a seacoast fort had more conventionally designed fronts facing the landward sides, or else some type of outwork with earthen parapets.

The defender of a fort might respond to the opening of second parallel with a sortie or sally intended to delay and disrupt operations and destroy some of the enemy guns before they could be brought into action. Guns could be spiked or their carriages burned. Then the defenders would withdraw before the besieger could bring up his reserves. Such a sortie could be launched at any time; there was less risk of being cut off if it were directed at parties working near the fort. The defender might also push out counter-approaches on each side of the saps, so as to rake them with his fire, or he might begin work on a mine sinking a shaft under some area sure to be used by the besieger.

Meanwhile, the attacker might begin new saps from his second parallel. Incidentally, the saps were about three feet deep and two and one-half feet wide, with a three foot parapet of earth-filled gabions on the side facing the fort, and the parallels were about ten to 18 feet wide and six feet deep from the crest of the parapet to the bottom of the trench.[14] The attacker too might start a mine from his positions. He could then extend the shaft under some part of the enemy's work and explode a charge of powder there.

The third parallel was dug at the foot of the fort's glacis or about 60 yards from its most advanced salients. Beforehand, however, the sappers dug half parallels between the second and third positions. Troops in these could protect the saps until work on the parallel itself was complete. Although the enemy's guns had usually all been dismounted by this time, the final preparations were quite risky thanks to the dangers of ordinary musketry, wall pieces' fire and tossed shells or grenades. The besiegers had to keep in their trenches all the time and worked more slowly.

The attacker could storm the covered way under protection of fire from stone mortar batteries, and send the sappers quickly to dig in along the crest of the glacis. Otherwise, the sappers dug out to each side so as to enclose the

salient and erected a mound called a trench cavelier from which marksmen could fire on the covered way. Next, the sappers dug up the glacis to within six yards of the salient place of arms and extended their trenches along the sides. This was called "crowning the covered way." Now the attacker could bring up his breeching batteries to the salients and knock down sections of the scarp walls of the outworks or bastions. He could also open breaches with mines. Under cover of their batteries the sappers could dig a trench across the ditch and prepare a position around the breach on the other side. Often there were outworks which had to be taken before a bastion could be stormed. A defender might try to close the breaches with some obstruction, such as a cheval-de-frise, or he might retreat to an interior retrenchment or some fortified inner structure (as a citadel or keep). It was only a question of time. Once the scarp of the main work had been breached the defender usually surrendered.[15]

If a fort had poorly supported outworks, was weakly garrisoned or if there were cover in front of the fort, then the attacker could use accelerated siege techniques. In this case storming parties siezed the outworks and the trenches, and were extended backwards to form a reserve position in case a counter-attack drove the besieger from the outworks.[16]

General Washington used Vauban's method to reduce the British position at Yorktown (1781), General Winfield Scott employed it at Vera Cruz (1847). In fact generals continued to employ modified forms of it as late as the American Civil War, as at the siege of Fort Wagner. That was almost 200 years after Vauban had developed it![17]

## *FOOTNOTES*

1. Enguenand de Monstrelet, *The Chronicles of . . . , Containing An Account of The Cruel Civil Wars between The Houses of Orleans and Burgundy; of The Possession of Paris and Normandy by The English; Their Expulsion Thence; and of Other Memorable Events That Happened in The Kingdom of France as well as in Other Countries: A History of Fair Example, and of Great Profit to The French beginning at The Year MCCC, where that of Sir John Froissart Finishes, and Ending at The Year MCCCLXVII, and Continued by Others To The Year MDXVI*, Thos. Johnes Tr. (London) UK: Geo. Routledge & Sons, 1867), Vol I, p. 403.
2. *Ibid.*, Vol. II, p. 174.
3. F. L. Taylor, *The Art of War in Italy 1494-1529*. "The West Point Military Library," Ed. T. E. Gries. (New York: The Greenwood Press, 1973), p. 143.
4. W. T., *The Compleat Gunner, in Three Parts: Translated out of Casimir, Diego Uffano, Hexam and other Authors with a New Forward by O. F. G. Hogg* (London, Eng.: Rob. Pawlet *et al.*, 1672; Reprinted, Menston, Yorkshire, UK.: Scolar Press Ltd., 1971), pp. 82-85.
5. *Encylopaedia Britannica*, 11 Ed., Vol. X, pp. 675-725.
6. Sebastien Le Preste de Vauban, *A Manual of Siegecraft and Fortification*, tr. by

George A. Rothrock (Ann Arbar, Michigan: University of Michigan Press, 1968), pp. 99-101; Henry L. Scott, *Military Dictionary: Comprising Technical Definitions; Information on Raising and Keeping Troops; Actual Service, Including Makeshifts and Improved Materiel and Law, Government, Regulations, and Administration Relating to Land Forces* (New York, NY: D. Van Nostrand, 1863), pp. 258-262, 310.

7. Vauban, *A Manual of Siegecraft and Fortification*, pp. 41, 91-95, 157-159; Scott, *Military Dictionary*, pp. 551-552.
8. Vauban, *A Manual of Siegecraft and Fortification*, pp. 28, 38, 45-51; Scott, *Military Dictionary*, p. 553.
9. John Muller, *A Treatise of Artillery* (1780; Ottawa, Ontario: Museum Restoration Service, 1965), pp. 166-176; John Gibbon, *The Artillerist's Manual* 1860; Glendale, NY: Benchmark, 1970, pp. 443-457.
10. Scott, *Military Dictionary*, p. 553.
11. See N. 8, *supra*
12. D[ennis] H. Mahan, *A Complete Treatise on Field Fortification, with The General Outlines of The Principles Regulating the Arrangement, the Attack, and the Defense of Permanent Works*, "The West Point Military Library" Ed. T. E. Gries. (1836, New York, NY: Greenwood Press, 1968), pp. 215, 230, 234.
13. *Ibid.*, p. 233.
14. Vauban, *A Manual of Siegecraft and Fortification*, pp. 54, 123, 128-129, Plates V, VI; John Muller, *A Treatise Containing the Elementary Part of Fortification, Regular and Irregular* (London, UK: 1746: Ottawa, Ontario: Museum Restoration Service, 1968), p. 227; Scott, *Military Dictionary*, pp. 556-557.
15. Vauban, *A Manual of Siegecraft and Fortification*, pp. 70-81, Plates XII, XIV, Mahan, *A Complete Treatise on Field Fortification*, pp. 238-240; Scott, *Military Dictionary*, p. 553.
16. Vauban, *A Manual of Siegecraft and Fortification*, pp. 97-99.
17. For Yorktown see: Howard C. Rice, Jr. and Anne S. K. Brown Eds., *The American Campaign of Rochambeau's Army 1780, 1781, 1782, 1783* (Princeton, NJ: Princeton University Press, 1972); for Vera Cruz see: Justin H. Smith, *War with Mexico* (Gloucester, Mass.: Peter Smith, 1963), Vol. II, pp. 17-36 and *An Artillery Officer in The Mexican War 1846-7; Letters of Robert Anderson, Captain, 3rd Artillery U.S.A.* (Freeport, NY: Books for Libraries, 1971); for Fort Wagner see: *The War of The Rebellion: A Compilation of The Official Records of The Union and Confederate Armies* (Washington, DC: GPO, 1880-1901), Series I, Vol. XXVIII, Pt. 1, pp. 3 f; Report of Major General Quincy Gillmore, Volunteers, to Brigadier General G. W. Cullum, Chief of Staff, February 28, 1864.

# Stone Walls and Iron Guns: Effectiveness of Civil War Forts

Orthodox historical opinion holds that the American Civil War proved that masonry fortifications were obsolete since they were helpless to resist rifled guns. As the 1971 *Prospectus* for Fort Pulaski puts it "Fort Pulaski and all the other forts in the coastal chain were obsolete after the 30-hour bombardment (of 1862). The chain was never completed since the walls were now useless against the new weapon."[1] This view is also supported by Dr. E. R. Lewis in his fine work on seacoast fortification. "Rifled cannon," he wrote, "even the fairly primitive muzzle loading varieties of 1861-1865 were capable of accomplishing quickly what smoothbores could do, only after long, tedious bombardments — the reduction of vertical walls to rubble. Because of their heightened effectiveness, rifled guns could do significant damage in single hits, and in this lay their historical triumph over masonry."[2]

Recently Williard B. Robinson has expressed the same opinion in his work on American forts.[3] This view was also that of some military thinkers of the Civil War period, particularly naval and artillery officers. Major General David Hunter, contemplating the fall of Fort Pulaski declared: "The result of this bombardment must cause . . . a change in the construction of fortifications as radical as that foreshadowed in naval architecture by the conflict between the Monitor and Merrimac." "No works of stone or brick," he observed, "can resist the impact of rifled artillery of heavy caliber."[4] Rear Admiral David D. Porter stated that "Our frowning stone works with their guns all standing out *en barbette*, and with others looking through small ports, and mounted in enclosed casemates, give a feeling of security, and seemed to bid defiance to the strongest foe; while in fact both arrangements are glaring defects, and a most prominent evidence of the weakness of our forts."

"There is not a fort in the United States," the Admiral declared, "that could not be silenced by ships if a sufficient number were assigned to the task."[5] Doubts about the propriety of masonry parapets had been reflected earlier in the writings of Louis de Tousard as well.[6]

Yet just how correct were these views? It would be interesting to re-

examine the question. I would even like to advance a heretical opinion, namely that casemated and other permanent forts were much more successful than their detractors admitted, and that they generally performed up to expectations.

Several ideas emerged from my exploration of pre-Civil War theories of fortification as Dennis H. Mahan and others expressed them. First, in order to be useful a seacoast fort had to be at least strong enough to compel any attackers to land a strong force equipped with heavy artillery and besiege it. Forts were meant to delay an enemy, not to hold out forever. Secondly, no casemated front could withstand the fire of entrenched siege artillery. Thirdly, ships would find it difficult to silence the casemated guns of a permanent fort without the aid of entrenched siege artillery.[7]

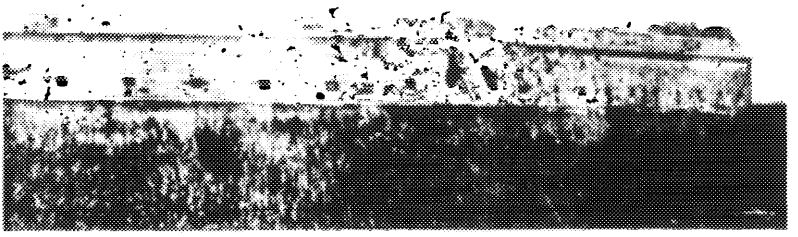
Several events have traditionally been singled out as proof of the helplessness of the permanent forts of the Third System: the reduction of Forts Pulaski, the destruction of Fort Sumter, the capture of Forts Jackson, St. Philip, Macon, Morgan and Gaines. In fact the first two actions were essentially sieges in which land-based artillery was employed against forts with exposed masonry. Forts Pulaski and Sumter were both pentagonal casemated forts of polygonal design. Major General Quincy A. Gillmore summarized his experience with Forts Pulaski and Sumter, South Carolina (1862-3) thus:[8]

> The old maxim that [seacoast] "forts cannot stand a competent land attack, but are able to resist and repel vessels" is a maxim still. It has been amply illustrated during the present war. Fort Pulaski fell before an attack from land batteries, breaching in the line of its principal magazines while the possibilities of reducing it by fire of the fleet were not even discussed by military and naval men.
>
> Fort Sumter in April 1863, repulsed in forty minutes Admiral Dupont's gallant attack with nine ironclads, eight of which were of the most formidable class, yet that work was easily demolished by shore batteries.

Did these events really prove that all masonry fortifications were totally useless, as some have said, or did they prove something more limited? This question is worth re-examination.

The siege and reduction of Fort Pulaski (February 22 - April 11, 1862) did not prove works with exposed masonry ineffective against ships but it did show the effectiveness of siege rifles against such works. Fort Pulaski stands on Cockspur Island, Georgia guarding the Savannah River. It was armed with 48 guns at the time of the siege. Twenty of these could bear on the site selected for the batteries. Only one of these was a rifle. The fort was garrisoned by 385 troops.[9]

General Gillmore after much labor established 11 batteries on Tybee Island at distances of 1,740 to 3,400 yards, from the fort. The total of 36 pieces included five 30-pounder Parrotts, one 48-pounder James Rifle, two 64-pounder James Rifles, (converted Smoothbore Guns) and two 84-pounder James Rifles.[10] The ranges at which the batteries had been established were far greater than the 700 yards accepted as the maximum breaching distance



*Effect of fire of federal breaching batteries on Fort Pulaski is clearly shown demonstrating the long range destructive power of rifled siege artillery. Library of Congress photo.*

for smoothbores.[11] In addition to two infantry regiments and two companies of artillery, two companies of engineers also labored on the project.[12]

In only two days' firing the fort was breached and surrendered, chiefly because of danger to its principal magazine which contained several thousand pounds of powder. Unfortunately for the defenders Fort Pulaski's 7½-foot-thick walls had been subjected to siege artillery fire, now effective at more than twice the ranges of former times. Eleven of Fort Pulaski's guns were put out of action as well. The fire of 13-inch mortar batteries and 10-inch columbiad smoothbore guns was less useful.[13]

Admiral Samuel F. Dupont's attack on Fort Sumter (April 7, 1862) showed that seacoast forts with exposed masonry could repulse an attack by armored warships of the period. Admiral Dupont had eight monitors each mounting two powerful guns and an older ironclad, the *New Ironsides*. The armament of the ships included 22 11-inch smoothbore guns, 7 15-inch smoothbores and 3 8-inch Parrott rifles.[14] At the time Fort Sumter mounted 80 guns and was held by 550 men. The heaviest of the guns mounted at the fort were 10-inch Columbiads and 7-inch Brooke rifles. The attack lasted about 2½ hours. Although the fort was pock marked by 34 hits, only about 15 did any serious damage. Two embrasures were knocked out and the shells pierced the 5-foot thick walls at three points.[15] On the other hand the fort disabled five ironclads. The *Keokuk* came within about 550 yards of the fort, and sustained 90 hits of which 19 pentrated. The *Nahant* suffered 36 hits, had her steering gear damaged and bolts and other iron work thrown about inside. The other vessels had their gun turrets jammed. The *Keokuk* sank the following day.[16] Clearly the stout masonry casemates with their concentrated artillery were still equal to the early ironclads. The ships could have certainly passed the fort had the channel not been obstructed[17] but they could not reduce the fort without siege guns mounted on dry land.

The destruction of Fort Sumter (July 23 - August 24, 1863) confirmed the traditional view, that forts with unprotected masonry were highly vulnerable to the fire of siege artillery, at the same time making the long range accuracy and hitting power of heavy rifles very apparent. In order to protect Fort Sumter, which stood in the middle of the entrance of Charleston Harbor, Confederate forces constructed Fort Wagoner near the southern end of Morris Island, the closest point of land at which breaching batteries might be erected to fire on Fort Sumter. The Confederates underestimated the range at which

*Interior of breached casemate, Fort Pulaski: the place surrendered because of fear shells might set off powder magazine on opposite side of fort. Library of Congress photo.*

rifled artillery would be effective and this error resulted in the destruction of the fort in its original form.[18]

After a preliminary effort to storm Fort Wagoner ended in failure, General Gilmore extended a system of regular approaches against Fort Wagoner. He decided to destroy Fort Sumter without waiting for the fall of Fort Wagoner so he entrenched eight batteries mounting two 80 pounder Whitworth rifles, nine 100 pounder Parrotts, six 200 pounder Parrots and one 300 pounder Parrott placed from 3,428 yards to 4,290 yards from Fort Sumter. The first great bombardment began on August 17 and by the 24th of that month Fort Sumter was a ruin. It was reduced at a range more than twice as great as the maximum range for most smoothbore siege guns. Besides the artillery some 17,000 troops participated in the operation.[19]

Subsequently the Confederates converted the ruined Fort Sumter into a rubble work,[20] and although it held out for the rest of the war it does not figure further in an evaluation of permanent forts. Even though it had climbable slopes Union forces never succeeded in storming it.[21]

The siege of Fort Macon (April 12-26, 1862) illustrated several points about the effectiveness of permanent forts. Fort Macon, North Carolina was a small polygonal fort having its ditches flanked by counterscarp galleries. Its main armament was mounted *en barbette.* A glacis protected its scarp walls.[22] Major General Ambrose Burnside sent Brigadier General John G. Park against Fort Macon with four regiments, a battery of 30-pounder Parrott rifles, a battery of 10-inch siege mortars and a battery of 8-inch siege mortars. Accurate fire from the siege rifles disabled 19 of the fort's 21 guns and the mortar shell soon made it all but impossible to man any of them. However the glacis effectively shielded all but the top three feet of the scarp from fire. In this area the projectiles hit 41 times and pierced to a depth of 2 feet in places. The fort's commander surrendered without delaying until Union forces had gained his counterscarp, planted batteries there and breached his scarp. Nevertheless, the fort's small, 263 man force stalled the attackers for two weeks after the opening of the first trenches. This is all the more interesting since some of the defenders showed signs of disaffection from the Confederate cause. Warships had aided in the bombardment of the fort but their fire was much reduced by a heavy swell and they soon retreated beyond range of the fort.[23]

The attack on the defenses of Mobile Bay in August, 1864 provides more evidence that although ships might run past permanent forts only siege artillery could reduce a properly designed and sited fort. Everyone had heard how Rear Admiral David G. Farragut lashed his ships side by side in pairs and ran past Forts Morgan and Gaines on August 5, 1864,[24] but fewer know how the forts were taken.

Fort Gaines, on Big Dauphine Island stood opposite Fort Morgan on Mobile Point. Fort Gaines was a polygonal work with bastionets.[25] It was armed with four 10-inch Columbiads, two 7-inch Brooke Rifles, twelve or

fifteen old 24 and 32 pounder smoothbores plus five or six casemate flank howitzers of which two 10-inch guns and six 24 pounders bore on the land side of the work. All the main armament was mounted *en barbette*. Traverses and parados had not been completed at the time of the attack. The fort was held by 818 troops. A Union force of 1,500 and six 3-inch rifled field guns landed and invested the fort on August 3. Although the fort was provided with a glacis that protected its scarps, unfortunately for the defenders, a sand dune overlooked the work from the land side. Soon a battery of four 30 pounder Parrots was added and the fort surrendered. It had held out only five days.[26]

Fort Morgan was better prepared. It was a regular hexagon with casemated bastions. Its glacis was also complete, and its main armament although mounted *en barbette* was partly protected by sand bag traverses. Some sixteen out of 136 guns covered the land approaches. There was also a water battery added by the Confederates. Fort Morgan had a defensible barracks or citadel, which, although it might have been useful had a sudden attack been launched, was badly designed to stand up under heavy mortar fire. Some 400 effectives held the fort.

Major General Gordon Granger landed 2,000 Union troops on August 9 to attack Fort Morgan. He established his first parallel in an old Confederate trench 1,400 yards from the fort. Eight 30 pounder Parrotts were emplaced along with some 9-inch Dahlgrens borrowed from the Navy and sixteen siege mortars. Fortunately for the attackers, sand hills provided good cover. The second parallel was soon completed and a sap pushed out towards the fort. Mortars set fire to the citadel and riflemen seized the covered way. After a two week seige Fort Morgan surrendered.

Although batteries and ships had fired on Fort Morgan from every direction it was still defensible. Its parapets and upper scarp had suffered heavily and one of the bastion casemates had been penetrated when three rounds from a ship had passed down a ditch. Nevertheless the fort's scarp remained to be breached.[27]

The case of Forts Jackson and St Philip remains. Ships actually silenced these defenses of New Orleans during the period from April 16 to 28, 1862. Fort Jackson was similar to Fort Morgan, Fort St. Philip was an irregular bastioned work left over from Spanish colonial days. Both stood on marshy ground facing each other across the principal channel of the Mississippi River. Unlike Fort Morgan, Fort Jackson had a wet ditch and casemated batteries covering the channel. Its parapets were not carried around the bastions for fear that the weight would cause subsidence. Instead, the terreplein had been excavated out so that the bastions' scarps formed parapets suitable for infantry defense. Consequently the cover over the casemate arches below must have been thin there. Fort Jackson and its exterior battery were armed with 45 heavy guns mounted *en barbette*, 20 in casemates, 6 mortars and 2 light pieces, while Fort St. Philip and its exterior batteries

mounted 43 guns *en barbette*, 7 heavy mortars and 3 field pieces. Fort Jackson included a defensive barracks similar to that at Fort Morgan.[28] Commander David Porter reduced the forts with a flotilla of 21 13-inch mortar boats after Flag Officer Farragut passed them with the main fleet. The Union forces were aided powerfully by the demoralization of the garrisons from causes not directly related to the attack, but most of all by the wooded river bank that formed a natural parapet and cover for the boats. Thus we had the unusual spectacle of a fleet sheltered from defensive fire behind earthworks.

Although the walls of the fort remained basically intact, the garrisons of the forts mutinied, forcing their surrender after just two weeks' bombardment. Fort Jackson's walls had been scarred and pitted by the heavy mortar shells but the only serious damage occurred at two casemates including one where three bombs hit close together and cracked open the arch. The citadel had also burned out days before the surrender. Hits on the levee had caused minor flooding in the casemates resulting in discomfort for the garrison.[29]

**TIME TO DESTROY OR REDUCE A FORT DURING THE CIVIL WAR**

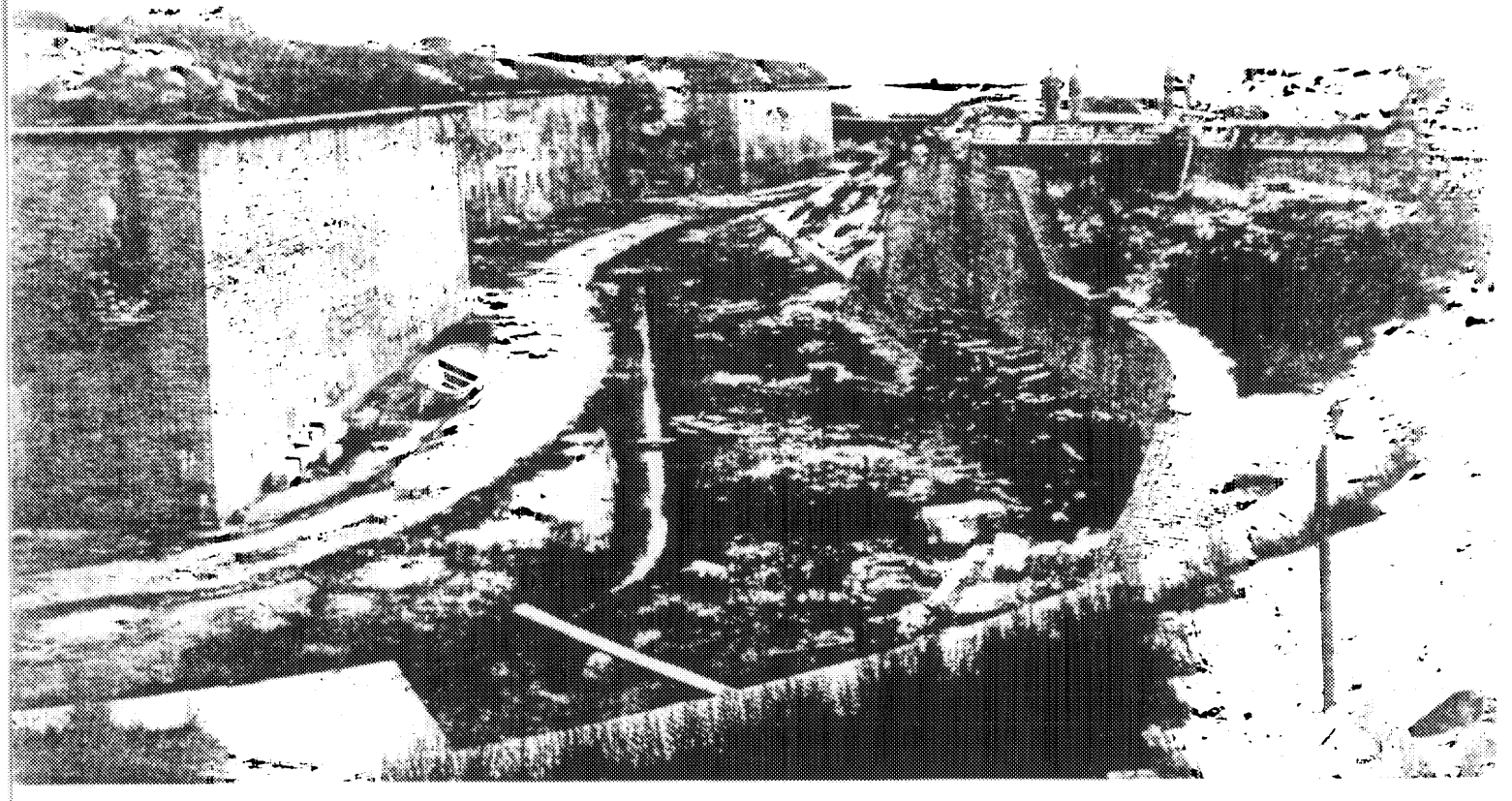
| | Fort Name | Exposed Masonry | Main Fort Batteries | Ships Alone | Siege Artillery | Formal Attack | Time in Days[A] |
|---|---|---|---|---|---|---|---|
| 1. | Pulaski | yes | casemated & barbette | no | yes | no | 17 |
| 2. | Sumter | " | " | " | " | " | 31[B] |
| 3. | Macon | no | barbette | " | " | yes | 14 |
| 4. | Gaines | " | " | " | " | no | 5 |
| 5. | Morgan | no[C] | " | " | yes | yes | 15 |
| 6. | St. Philip | partly | " | yes | no | no | 12 |
| 7. | Jackson | partly | casemated & barbette | " | " | " | 12 |
| | | | | | | | 106 |
| Average Time | | | | | | | 15.1 |

A. From the start of bombardment or opening of the trenches, whichever was sooner, until the end of the siege or ruin of the fort.

B. Until the ruin of the original masonry fort.

C. Due to the distance between the crest of the glacis and the scarp the latter might be struck by some long range shots, perhaps 3/25ths of those fired. This was due to curve of the descending branch of the trajectory.

These actions revealed major faults in the design of permanent forts but they did not prove that the use of masonry revetments was obsolete. Clearly Fort Jackson could have been constructed at a bend of the river so that warships would have to approach it bow first and would have difficulty bringing broadsides to bear. This would have also eliminated the covered positions and increased the time ships would have been under fire. Citadels should have been designed so as to be bomb proof. Heavier masonry could have been employed. Guns covering land approaches could have been



*Front and west sides Fort Morgan showing hits from long range, plunging fire. Library of Congress photo.*

mounted at embrasures instead of *en barbette*. Earth parapets would have helped some forts. Some ditches could have been narrower so the glacis would protect better. Nevertheless, the forts did hold out awhile.

The Civil War showed that the permanent fortifications had considerable powers of resistance. In most cases it was necessary to entrench seige artillery to reduce them. If their masonry were covered by proper glacis a formal attack might be required, but even forts with exposed masonry could hold up land forces a few days. The forts met the requirements of the engineers who designed them although they may have failed to live up to the unrealistic expectations of some who were too impressed by their formidable appearance. This may have been an early manifestation of the "Maginot line complex." That is another story.

What is interesting is that the human factor was a major element in the holding or falling of a fort. Every rule of war indicated that Forts Macon, St. Philip and Jackson should have held out. None of these was breached, yet they surrendered. Fort Sumter, on the other hand, should have fallen. Surely a plucky garrison was the best asset of a fort under attack. Seldom did the Confederate garrisons attempt a last ditch resistance. Yet average time to take a fort was about two weeks. This time period compares fairly closely with Vauban's estimate of 15 to 20 days from the opening of the trenches to the establishment of the first lodgement in a fortress under attack.[30]

Clearly, ships alone could not normally take a fort, their rifled guns notwithstanding. Here were forts doing what was expected, tying up enemy manpower and delaying his movements. None of these forts was silenced by a naval cutting out party, a few marines landing with, say a 12 or 6-pounder. Most naval attacks were made to assist land attacks. Otherwise they were apt to prove futile. No fort was graped into submission by a man-of-war.

Although rifled guns did not make masonry forts obsolete overnight they did powerfully strengthen the hand of the besieger. Fort Sumter was demolished by batteries from 3,500 to 4,200 yards away, a feat that would have been impossible with smoothbores. Certainly many fortifications with exposed masonry built in what were once isolated positions would now be vulnerable to attack by land-siege batteries. New works would be required to prevent the construction of such batteries within range of the vulnerable forts. However, there was little indication that ships could reduce permanent forts without the aid of land forces. Individual rifle projectiles might penetrate into the masonry but the gun crews could not hit the same spot repeatedly. The motions of the ship prevented it. Fire from a sheltered position on quiet waters might be more effective, but such conditions rarely occurred.

This story has an epilogue: in 1898 the United States fleet tested its rifled breech-loading guns against ancient Spanish fortifications guarding San Juan, Puerto Rico. The results were disappointing to say the least. On May 12, 1898 an American fleet bombarded the fortifications, including Morro Castle. The Battleship *Iowa* and the Cruiser *Detroit* both gave Morro Castle

some attention, the former employing her 8-inch secondary battery.[31] Commander J. H. Dayton of the Detroit reported:

> At 5.15 the *Iowa* having commenced firing, the *Detroit* opened fire with her port battery on the northern face of Morro . . . . The behavior of every one on board was excellent. The only fault I found was a tendency to fire more rapidly than the circumstances justified. From this cause and the ground-swell a considerable amount of ammunition was wasted.
>
> The battery was practically in the same condition after as before the engagement.

A National Park Service brochure sums it up neatly: *"Dos horas y media duro el bombardeo a la plaza de San Juan. Por fortuna no hubo que lamentar grandes danos."*

## *FOOTNOTES*

1. A Swift Ed, *Interpretive Prospectus, Fort Pulaski National Monument, Georgia* (Southeast Regional Office, N.P.S., June 16, 1971), p. 2.
2. E. R. Lewis, *Seacoast Fortifications of The United States: An Introductory History* (Washington, DC: Smithsonian Press, 1970), p. 67.
3. Willard B. Robinson, *American Forts, Architectural Form and Function* (Urbana, IL: University of Illinois Press, 1977), pp. 126-132.
4. *The War of The Rebellion: A Compilation of The Official Record of The Union and Confederate Armies* (Washington, DC: GPO, 1880-1901; hereafter cited as *War of the Rebellion Records*) Series I, Vol. VI, p. 133, Report of Major General David Hunter to Hon. E. M. Stanton, Secretary of War, April 13, 1862.
5. [Viktor E. K. Rudolf] von Scheliha, *A Treatise of Coast Defense: Based on The Experience Gained by Officers of The Corps of Engineers of The Army of The Confederate States, and Compiled from Official Records of Officers of The Navy of The United States. Made During The Late North American War from 1861 to 1865* (London, UK: E. & F. Spon, 1868; Reprint "The West Point Military Library," J. E. Greis *et al* eds. New York, NY: Greenwood Press, 1971), pp. 158-173, Rear Admiral David G. Porter to Hon. Gideon Welles, Secretary of the Navy, February 1, 1865.
6. Louis de Tousard, *American Artillerist's Companion, or Elements of Artillery* (Philadelphia, PA: C. & A. Conrad, 1809-13; Reprint "West Point Military Library, T. E. Greis *et al.* eds., New York, NY: Greenwood Press,1969), Vol. I, p. 65.
7. D [ennis] H. Mahan, *A Complete Treatise on Field Fortification with The General Outline of The Principles Regulating the Arrangement, the Attack and the Defense of Permanent Works.* (1836; Reprint, "The West Point Military Library," T. E. Griess *et al* eds., New York, NY Greenwood Press, 1968), p. 223;_____, *An Elementary Course of Permanent Fortification* for The Use of the Cadets of the Cadets of the US Military Academy (New York, NY: John Wiley & Son, 1874), pp. 2, 95; J. G. Bernard, *Notes on Sea Coast Defence: Consisting of Sea Coast Fortification, The Fifteen-Inch Gun, and Casemate Embrasures* (New York, NY: D. Van Nostrand, 1861), pp. 95-96; Robinson, *American Forts*, p. 91. Permanent forts were supposed to hold out from 10 to 50 days. Naturally, the number of

outworks and other factors could be expected to influence the duration of resistance.

8. *War of the Rebellion Records*, Series I, Vol. XXVIII, Pt. 1, p. 35, Report of Major General Quincy A. Gillmore, Volunteers, Department of The South, to Brigadier General G. W. Cullum, Chief of Staff, February 28, 1864.
9. *Ibid.*, Series I, Vol. VI, pp. 148-165, Report of Major General Quincy A. Gillmore, Volunteers, to Adjutant General, U. S. Army, October 20, 1865.
10. *Ibid.*, Also see *Official Atlas*, Plate 5.
11. *War of the Rebellion Records*, Series I, Vol. VI, pp. 148-165, Report of Major General Quincy A. Gillmore, Volunteers, to Adjutant General, U. S. Army, October 20, 1865.
12. *Ibid.*
13. *Ibid.*
14. John Johnson, *The Defense of Charleston Harbor Including Fort Sumter and the Adjacent Islands 1863-1865* (1889; Reprinted: Freeport, NY: Books for Libraries, 1970), pp. 43, 45.
15. *Ibid.*, pp. 41, 44, 56-58.
16. Scheliha, *A Treatise of Coast Defense*, pp. 125-153, Report of Rear Admiral Samuel F. Dupont, April 15, 1863: Report of Commander John Downes, U. S. *Nahant*, to Rear Admiral S. F. Dupont, April 13, 1863; Report of Commander A. C. Rhind, U. S. *Koekuk*, to Rear Admiral S. F. Dupont, April 8, 1863.
17. Scheliha, *A Treatise of Coast Defense*, p. 47.
18. *War of The Rebellion Records*, Series I, Vol. XXVIII, Pt. 1, pp. 3-39, Report of Major General Quincy Gillmore, Volunteers, to Brigadier General G. W. Cullum, Chief of Staff, February 28, 1864.
19. *Ibid.*; Johnson, *The Defense of Charleston Harbor*, pp. 115-134.
20. *War of The Rebellion Records*, Series I, Vol. XXVIII, Pt. 1, pp. 23, 30; Report of Major General Quincy Gillmore, Volunteers, to Brigadier General G. W. Cullum, Chief of Staff, February 28, 1864. Johnson, *The Defense of Charleston Harbor*, p. 134 & f.
21. Scheliha, *A Treatise of Coast Defense*, pp. 10-14, Report of Lieutenant Commander E. P. Williams, U.S.N., to Hon. Gideon Welles, Secretary of the Navy, September 27, 1864. However, surviving portions of the original vertical walls seem to have played an important role in the failure of an attack from boats.
22. Robinson, *American Forts*, p. 104.
23. *War of The Rebellion Records*, Series I, Vol. IX, pp. 281-294; Report of Brigadier General Jno. G. Parke, Third Brigade, to Captain Lewis Richmond, Assistant Adjutant General, May 9, 1862; Report of Lieutenant Daniel W. Flagler, U.S. Ordnance Department, to Captain Charles T. Gardner, Assistant Adjutant General, April 29, 1862; Report of Captain Lewis O. Morris, 1st Arty, Company C, to Captain Charles T. Gardner, Assistant Adjutant General, April 28, 1862; Report of Colonel Moses J. White, C.S.A., to Major General T. H. Holmes, North Carolina Forces, May 4, 1862.
24. Scheliha, *A Treatise of Coast Defense*, pp. 106-114; W. G. B. Squadron, General Orders 10, 11, July 12, 29, 1864; Report of Rear Admiral David G. Farragut to Hon. Gideon Wells, Secretary of the Navy, August 12, 1864.
25. Robinson, *American Forts*, pp. 115-122.
26. *War of The Rebellion Records*, Series I, Vol. XXXIX, Pt. 1, pp. 408-411, Report of Captain M. D. McAlester, Chief Engineer, Military Division of West Mississippi, to Brigadier General R. Delafield, Chief Engineer, U. S. A., August 20, 1864.

27. Scheliha, *Treatise on Coast Defense*, pp. 18-20; *War of The Rebellion Records*, Series I, Vol. XXXIX, Pt. 1, pp. 411-15, 438-441, Report of Captain M. D. McAlester, Chief Engineer, Military Division of West Mississippi, to Brigadier General R. Delafield, Chief Engineer, U.S.A., September 9, 1864; Report of Brigadier General Richard L. Page, C.S.A., to Major General D. H. Maury, August 30, 1864; *Official Atlas*, Plate 63. Also see *War of The Rebellion Records*, Series I, Vol. XXXIX, Pt. 2, pp. 706-707, Lt. Col. V. Sheliha, Chief Engineer, Dist. of Gulf, to Col. G. G. Gardner, Chief of Staff, July 9, 1864, Lt. Col. V. Sheliha, Chief Engineer, to Capt. J. V. Gallimard, Engineer in Charge Lower Bay Line, July 10, 1864.

28. Robinson, *American Forts*, pp. 89-95; *War of The Rebellion Records*, Series I, Vol. VI, pp. 508-510, Report of Brigadier General John W. Phelps, U.S.A., to Major George Strong, Assistant Adjutant General, April 30, 1862; *Official Records of The Union and Confederate Navies in The War of The Rebellion* (Washington, DC: GPO, 1895-1922), Series I, Vol. XVIII, pp. 14-23, Instructions, Gideon Welles, Sec. of the Navy to Flag Officer Farragut, February 10, 1862. Probably not more than 28 of Fort St. Philip's guns were in the work proper.

29. *War of The Rebellion Records*, Series I, Vol. VI, pp. 508-510, Report of Brigadier General John W. Phelps, U.S.A. to Major George Strong, Assistant Adjutant General, April 30, 1862; Report of Brigadier General Johnson K. Duncan, C.S.A., to Major J. G. Pickett, Assistant Adjutant General, Dep. 1, April 30, 1862; Scheliha, *Treatise on Coast Defense*, pp. 21-26, 48-77, Report of Joseph Harris to F. H. Gerdes, Esq., Assistant, U.S. Coast Survey, May 4, 1862; Report of Flag Officer David D. Farragut to Hon. Gideon Welles, Secretary of The Navy, April 30, 1862; Report of Commander David G. Porter to Hon. Gideon Welles, Secretary of The Navy, April 30, 1862. This was not the first time Fort Ft. Phillip had been attacked by mortar bombs. It had successfully resisted British attack for nine days in 1815 despite 1000 shells thrown at it. Six times that many fell into Fort Jackson in 1862. See Paris M. Davis, *An Authentic History of the Late War between the United States and Great Britain* (2nd Ed., New York, N.Y.: Ebenezer F. Barker, 1836), p. 260.

30. Sebastien Le Prestre de Vauban, *A. Manual of Siegecraft and Fortification*, tr. George A. Rothrock (Ann Arbor, Michigan: University of Michigan Press, 1968), pp. 140, 164.

31. Harper's *Pictorial History of The War with Spain With an Introduction by Maj. Gen. Nelson A. Miles* (New York, N.Y.: Harper Brothers, 1899), pp. 262-263, accounts of Commander Dayton, *USS Detroit*, Captain Chadwick, *USS New York*.

# Glossary of Technical Terms

ABATIS. A defensive obstacle made from felled trees or brush, branches sharpened and facing away from the work defended.

ADVANCED WORK. An independent secondary work being within cannon range of the main fortification.

ANGLE OF DEFENSE. The angle formed by one face and its opposite flank.

ANGLE OF THE FLANK. The angle made by a curtain and flank.

ANGLE OF THE SHOULDER. The angle formed by a face and flank of a bastion.

APPROACHES. The trenches of a besieger used to move in toward the work under attack.

ARROW. A work placed at the salient of a glacis with a caponier or communication back to the covered way.

BANQUETTE. A raised masonry or earthen bank behind a parapet for soldiers to stand on when firing from a work.

BANQUETTE SLOPE. The rear slope of a parapet facing the interior of a work and supporting the banquette tread or firing step.

BARBETTE. Guns were said to be en barbette when mounted to fire directly over the parapet instead of through embrasures.

BARTIZAN. A small masonry turret hanging out from a wall, usually at a salient angle, and supported on corbels. Bartizans were used in Spanish fortifications as sentry boxes.

BASTION. A projecting part of a fortification, usually at the angles or corners, having two faces and two flanks, so constructed that the adjacent curtain might be defended from it. A bastion was described as full when its interior was on the same level as the terreplein and hollow when its interior was below that level.

BASTIONET. A very small full bastion, sometimes casemated.

BASTION HEAD. A field work with two faces and two converging flanks.

BATARDEU. A solid masonry barrier 7 or 8 feet thick crossing the entire breadth of the ditch opposite the flanked angles of the bastion. It served to keep portions of a ditch flooded.

BATTERY. Two or more guns, or an entrenchment for them, usually consisting of a parapet 7 to 8 feet high and 18 to 20 feet thick with embrasures, usually ditched in front. See elevated battery and sunken battery.

made of masonry in permanent works and of planks, gabions, sods, posts, facines or sandbags in field fortifications.

RICOCHET FIRE. A technique involving loading guns with light charges and elevating them 10 or 12 degrees so as to send the shot over the parapet and bounce it along the rampart.

SALIENT. The angle at the projecting point of a bastion, ravelin, redan or other fortification.

SALIENT BASTION. In polygonal fortification, the bastion or bastionet at the junction of two faces.

SALLY PORT. A narrow entrance leading from the terreplein or banquette of the re-entering place of arms to the glacis. Also, a postern was sometimes called a sally port, but the name has often been misapplied to the main gate of a fortification.

SAP ROLLER. In sieges, a roller made of two large concentric gabions 6 feet in length; the outer one 4 feet in diameter, the inner one 2 feet, 8 inches. The intervening space was filled up with pickets of wood so make them musket proof. The roller was used to protect the sappers when they were at work.

SAPS. In sieges, a sap was a trench by which the attackers could move closer to a hostile fortification. Saps were usually dug in zig zag patterns to prevent the enemy from raking them so effectively with his guns. See double sap & flying sap.

SAUCISSON. Either a long fuse of cloth or leather filled with powder for firing a mine or a very long fascine used in the erection of batteries and repair of breaches.

SCARP. A retaining wall for the rampart that also served to make escalade very difficult.

SEACOAST FRONT (OR MARITIME FRONT). A front designed chiefly for defense against ships. Usually such fronts were casemented but had scarp walls exposed to direct fire.

SEACOAST GUN CARRIAGE. A type of carriage having the barrel or tube on a top carriage which was in turn mounted on rails along which it could recoil. The rails or chassis pivoted on a pintle to allow easy traversing of the piece from side to side. This type of carriage, a part of the French Gribeauval System, was first introduced into the United States in the 1790's.

SECOND COVERED WAY. A covered way beyond the second ditch.

SECOND DITCH. A ditch, usually flooded, located beyond the glacis.

SECTOR OF FIRE. An arc covered by the fire of a gun.

SECTOR WITHOUT FIRE. The blind area in front of a salient angle.

SHOT. A cannon ball. Siege guns usually fired shot weighing from 18 to 42 pounds. Shot served to smash enemy gun carriages and breach fort walls.

SHOULDER ANGLE. In polygonal fortification, the angle formed by the junction of a face and flank.

SHOULDER BASTION. In polygonal fortification, a bastion or bastionet at the intersection of a face and a flank.

SHOULDER OF A BASTION. The junction between the face of a bastion and its

BATTERY ON A CAVALIER. A battery in which the platforms for the guns or mortars were raised above the natural level of the ground. Also called raised batteries, these were sometimes made in front of the first parallel, especially if the fort under attack were on higher ground.

BERM. A ledge between the edge of the ditch and the base of the parapet which served to keep the earth from sliding into the ditch.

BLIND. Two sticks joined together with two spars about 4 feet wide, used to shelter against a cross fire in siege operations.

BLOCKADE. An attack on a fortification solely by closing it off and denying its defenders provisions and supplies.

BLOCKHOUSE. A square, rectangular or polygonal structure of heavy timber or masonry situated to guard some isolated point against raids or at the diagonal angles of a picket work or similiar fort to provide flanking fire. A typical blockhouse might be two storied, 20 feet square at the base, 20 feet high, the bottom story constructed of squared 18 inch timbers and the overhanging second of 12 inch timbers. Both stories would have loop holes and the roof would be furnished with grated hatches for the escape of smoke. Also see keep. Another form of blockhouse used extensively in the American West during the post Civil War period consisted of two stories of equal size, but with the top story turned so that its corners projected over the centers of the first story's walls. This arrangement made it impossible to avoid much of the defenders' fire by attacking the structure from the corner. Sometimes an observation cupola, sentry box or walkway were added, but a simple hipped roof was more usual. Such a blockhouse was especially useful as an independent work when the dead angles could not be covered from the fort's curtain or from another blockhouse.

BODY OF A PLACE. See enceinte.

BOMB. A mortar shell.

BOMBARDMENT. An attack by firing bombs or shells into a fort to destroy its buildings.

BOMBPROOF. In field works, a shelter from bombardment.

BONNET. An outwork covering the salient angle of a ravelin.

BOYAU. See sap.

BREACH. A gap blasted in a wall or scarp large enough to permit entry. Guns or mines were used to make breaches.

BREAST-HEIGHT. See banquette.

BREASTWORK. In field fortification, a low parapet without a banquette, chiefly intended for protection against fire, or any low defensive work mainly designed as a protection from fire and not as an obstacle.

BULWARK. A circular work, originally of timber and earth, later of stone, erected to keep early siege guns out of range of town walls, or to shield and protect gates.

CALTROP OR CROW'S FOOT. A four pronged obstacle, usually of iron, sometimes used against cavalry. In later field fortifications, boards with nails driven through were often substituted.

CAPITAL. A line bisecting a salient angle.

CAPONIER. Either (1) a defensive structure erected in Sixteenth Century Italy to flank a cleared space between town walls and retrenchements or (2) the passage thrown across a ditch from the tenaille to the gorge of an outwork or the covered way. Normally this was from about 10 to 30 feet wide and covered by a parapet 7½ feet high on each side and a small glacis about 60 feet wide, (3) a masonry gallery often arched over so as to be bombproof, loop holed and constructed across a ditch so as to flank the curtain.

CARRONADE. A short iron cannon of large caliber designed for use at short ranges, originally for ships. Guns of this sort were later assigned for the flank defenses of fortifications.

CAVELIER. A work within a fort's enciente raised 10 or 12 feet higher than the rest of the works, and often used within a bastion or at its gorge.

CASEMATE. A room made under a rampart with loop holes or embrasures for guns, also a bombproof shelter for troops.

CASTLE. A fort, especially a large masonry tower casemated for seacoast defense.

CENTER OF A BASTION. The point where the curtains would intersect if extended into the bastion.

CHAMADE. A signal made by the besieged consisting of the beating of drums on the rampart next to the point of the attack and indicating a desire to capitulate.

CHAMBER. A room excavated at the end of a mine into which the powder would be placed.

CHEMIN DE RONDE. A passageway between a detached scarp and the foot of the exterior slope of a parapet.

CHEVAL-DE-FRISE. An obstacle (frequently used to block roads and breaches), that consisted of a stout timber or body about 9 feet long, often a piece of 5 inch square scantling, into which a number of holes 2 inches in diameter and 5 inches apart were drilled so that lances shod with iron points could be fixed into them radially.

CIRCUMVALLATION. A continuous entrenchment, often a line of redans, facing away from a besieged fortification and helping to prevent its relief. It was rarely used.

CITADEL. A stronghold within a fortification to which the defenders might retire as a last resort, similar in purpose to a castle's keep.

COMMAND. In a technical sense, the height of the interior crest of a rampart or parapet above the line of ground or plane of site; also, when a hill or work overlooked another it was said to command the lower work, if the latter were in range.

CORDON. A rounded stone projection running around a wall about 4 feet from the top and helping to protect the masonry from the weather.

COUNTERFORT. A buttress constructed on the inside of a scarp or parade wall to give it extra strength.

COUNTERGUARD. An outwork erected before the bastions to shelter their faces from breaching batteries placed on the covered way. Counterguards were also used before ravelins. The counterguard consisted of two faces joined to form a salient angle.

COUNTERMINE. A mine made to disrupt another mine. Usually the defenders used

them when they detected the attackers' mine.

COUNTERSCARP. A retaining wall for the far side of the ditch, opposite the scarp. Sometimes galleries were bu. ehind the counterscarps to allow defenders to rake the ditch with fire .

COUNTERVALLATION. Either a continuous entrenchment similar to the circumvallation, but facing the besieged fortification, or a series of separate entrenchments doing the same. This served to prevent a breakout.

COUP DE MAIN. An attack by storm as distinguished from a methodical reduction by siege, an insult.

COVERED WAY. A road about 10 to 12 yards wide around a fort beyond the ditch and sheltered by the glacis embankment, usually 7½ feet high.

COVER FACE. A low work erected in the ditch to shield the scarp from fire, especially from plunging fire, an interior glacis within the ditch. At Fort Warren, in Boston Harbor's works, such an earthen mask served to protect the scarp wall. Also see counterguard.

CROCHETS. Indentations cut into the face of the covered way embankment so defenders could pass around traverses.

CROWNWORK. An outwork with two demibastions flanking a complete one and often having long flanks. The crownwork was frequently used to enclose buildings which could not be included within the enceinte.

CUNETTE. A small ditch in the center of a dry ditch to drain off water.

CURTAIN. That portion of a wall or rampart running between towers or bastions.

CURTAIN ANGLE. The angle formed by the curtain and the flank of a bastion.

DEAD SPACE. An area right below the parapet that the guns could not be depressed to cover.

DECAGON. A ten sided fortification.

DEFENSIVE BARRACKS. Barracks built to serve as a keep, usually of masonry construction and loop holed.

DEMIBASTION. A projecting part of a fortification, having one face and two flanks, hence, a half bastion.

DEMIGORGE. At the rear of a bastion or outwork, the line between the capital and the flank or face.

DEMILUNE. See ravelin.

DETACHED BASTION. A bastion separated from the enciente by a ditch.

DETACHED SCARP. Also called a Carnot Wall, this was a scarp wall separated from its rampart by a space of several feet. Sometimes the scarps were made with tiers of arched recesses at the back and loop holes for musketry.

DETACHED WORK. An independent secondary work beyond cannon range of main fortification.

DITCH. A very large, deep trench surrounding fortifications. A wet ditch was filled with water, a dry ditch was not.

DOUBLE SAP. (See sap) When a parapet was thrown up on both sides of a sap it was called a double sap. Such saps were often used close to the enemy work.

DRAWBRIDGE. At an entrance to a work, a bridge that could either be drawn in or up or was weighted to rise when released, thereby preventing access to an enemy trying to cross the ditch and enter the work.

ELEVATED BATTERY. A battery in which the platforms for the guns or mortars were laid on the natural level of the ground, and having a parapet raised above it with earth from the ditch. See battery.

EMBRASURE. In a wall or parapet, an aperature or opening with sides flaring inward or outward, through which guns might be fired. In parapets for field works, they were usually about 2½ feet on the inside and 8 or 9 feet wide at the mouth, also about 3 feet deep. See Totten embrasure.

EMPTY BASTION. A hollow bastion. See bastion.

ENCEINTE. The main line of works enclosing a fortification and inside the principal ditch.

ENNEAGON. A nine sided fortification.

EPAGON. A seven sided fortification.

ESCALADE. An attack made by climbing over a wall or rampart, usually with the aid of ladders.

ESPLANADE. The level space separating a citadel of a fortress from the town, or, an open area inside a fortification used for drilling troops, a parade.

ESCARP. See scarp.

EXAGON. A six sided work.

EXTERIOR CREST. The crest of the exterior slope.

EXTERIOR SIDE OF A WORK. The side facing the enemy, also, an imaginary line drawn from one salient of a bastion to that of another, a front.

EXTERIOR SLOPE. The side of the parapet facing out from the work.

FACES. The portions of a bastion, demibastion or ravelin most nearly parallel with the fort's curtain. Also, in polygonal forts and field works, those portions of the enceinte most nearly parallel to the gorge.

FACINES. Bundles of sticks which were commonly used for revetments, etc. Usually they were about 6 or 8 inches in diameter. Extra long ones, about 16 feet long, were called saucissions.

FAUSSBRAY. A low rampart around the outside of the enceinte.

FIRE. The fire of guns was usually described in terms of the way it struck the target. Direct fire hit in front; enfilading fire took a target in flank; oblique fire, at an angle; reverse fire, from behind. Sometimes fire was described in terms of the trajectory of the projectiles. Thus we hear of the high angle fire of mortars, of cross fire, of plunging fire and of ricochet fire. Finally, fire may be classified according to the direction it is delivered, i.e. to the front, on the oblique, to the flanks.

FLANKS. Those parts of a bastion or demibastion connecting the faces to the curtain and

usually perpendicular to, or at an angle with the curtain, also those parts of outworks which defend the curtain or another work. In polygonal forts and field fortifications, those ramparts or parapets running perpendicular or almost perpendicular to the gorge, and connecting it with the faces.

FLAT BASTION. A bastion situated on a curtain wall between rather than at one of its angles.

FLYING SAP. (See sap) When fire from the defenders of a work was light the attackers could speed up their approaches by placing many gabions along the trench before filling them. This was called a flying sap.

FORTRESS. A fortified town.

FOUGASS. An early version of the land mine. A stone fougass resembled a modern claymore mine. Engineers dug a 6 foot shaft in a slope inclined to the horizontal at an angle of about 45 degrees. At the bottom they placed a charge of, say, 55 pounds of powder. Above this charge they put a strong wooden shield and three or four cubic yards of loose stones not weighing less than ½ pound apiece. A wire running through a hose or tube activated the firing device. Other versions of the fougass included boxes of live shells over a powder charge or simply powder charges.

FRAISES. A palisade that was either horizontal or slightly inclined. Often they would be fixed in the berm of a field work. At the bottom the fraise was usually joined by a 6 inch piece of scantling called the cushion, at the top by another piece called the riband. The points of a fraise were supposed to be 7 feet above the bottom of the ditch, and were not to project beyond the foot of the scarp lest they give shelter to any attackers who could reach the ditch.

FRONT. That part of a work lying between the apices of two salients or between the capitals, hence the basic unit of fortification.

FOURNEAU. See chamber.

FUZE. A means of igniting the bursting charge of a shell or bomb, usually consisting of a piece of wood hollowed out and filled with a powder composition timed to burn at a certain rate. It was cut to the proper length, driven into the shell before firing and ignited from the muzzle blast.

GABION. An open-ended basket used as a revetment in field fortifications and siege works, usually three feet high. Also see sap roller.

GALLERY. A shaft leading to a mine, usually 4½ to 6 feet high, 4 feet broad, supported by wooden frames or masonry.

GARRISON CARRIAGE. See siege and garrison carriage.

GENOUILLERE. The interior elevation of a parapet where an embrasure had been cut through was called a genouillere. This part of the parapet protected the lower portion of the gun carriage.

GLACIS. A natural or man made slope from the top of the counterscarp or covered way embankment (toward the open country) which gave the defenders a clear field of fire.

GORGE. (1) The inside space between the flanks of a bastion, or outwork, or (2) of an unbastioned polygonal fort, the rampart forming the base of the polygon, as at Fort Sumter, for example; or (3) the inside space between the faces or flanks of a field work,

sometimes left open.

GORGE ANGLE. In polygonal fortifications, the angle formed by the junction of the gorge with one of the flanks.

GORGE BASTION. In polygonal fortification a bastion or bastionet at the angle of the gorge and a flank.

GRENADE. A hollow 3-inch iron sphere filled with powder and thrown by grenadiers or others after the ignition of its fuze. Also, a similiar projective designed to explode on impact and furnished with vanes.

GUARD ROOM. A room near the entrance of the fort, often in a gate tower, where the guard was stationed. Often there was a cell for prisoners adjacent to the guard room. Sometimes the guard room might have a loop holed wall covering the passage from the main gate.

HALF BASTION. See demibastion.

HALF MOON. See demilune, a ravelin.

HORNWORK. An outwork consisting of two demibastions joined by a curtain and connected with the main work in the rear by almost parallel wings.

HOT SHOT FURNACE. A furnace for heating iron shot until they became cherry red. They were then fired at wooden vessels to set them afire.

HOWITZ. A shell for a howitzer.

HURDLES. Barriers about 3 feet high and 2 broad used to stop up breaches in besieged works.

HURTER. A piece of timber 6 inches square placed to prevent the wheels of gun carriages from damaging the parapet of a siege battery or field work, also, on the seacoast carriage, the pieces on either end of the chassis to keep the recoiling part of the carriage from running off.

ICHNOGRAPHY. A plan of the horizontal characteristics of a work.

INSULT. An open assault on a work.

INTERIOR CREST. The crest of a parapet's superior slope, the highest point of the parapet.

INTERIOR SIDE OF A FORTIFICATION. The imaginary line from the center of one bastion to the center of the next.

INTERIOR SLOPE. The nearly vertical and usually revetted slope between the interior crest and the banquette tread of a parapet.

INTERIOR WORKS. After a fort's scarp has been breached, it was sometimes possible for the defender to erect an earthwork, sealing off the endangered area. A usual interior work was a retrenchment of a bastion which had been breached, that is an earthwork thrown up across the gorge.

INVESTMENT. The surrounding of a work before a siege, so as to prevent its resupply or reinforcement.

KEEP, OR SAFTEY REDOUBT. In permanent fortification, a blockhouse in ravelin or behind a bastion to which troops could retire if it were overrun. In field works, a

similiar structure of timber and earth. Usually, these keeps were square or cross shaped. The sides were protected by two thicknesses of 12 inch thick lumber. The interior dimensions had to be at least 9 feet high and 20 feet wide. Loop holes were usually about 3 feet apart. Keeps were usually ditched.

LAND FRONT. A front of fortification designed to resist siege.

LEVEL OF SITE OR PLANE OF SITE. The original ground level.

LINES. Chains of field fortifications, either continuous entrenchments or works placed at intervals.

LINE OF DEFENSE. The line from a salient to its opposite flank.

LISTENING GALLERY. A tunnel, generally of masonry, extending under outworks and serving as a place from which to detect the sound of mining operations and start a countermine.

LODGEMENT. A foothold gained by attackers in some part of a work.

LOOP HOLES. (Or loops) Square or oblong holes in a wall to allow troops to fire through it. Often they were about a foot long and 8 inches wide on the inside, tapering to 4 and 2½ inches on the outside.

LUNETTES. In permanent fortification, works built on both sides of a ravelin, with one of their faces flanked by the ravelin and the other by the bastion, also, a ravelin-like work erected beyond the second ditch. In field works, a work with two faces and two parallel flanks, open at the gorge. It was also called a bastion head when the flanks were diverging, not parallel.

MACHICOULIS. A construction to allow fire at the foot of a wall without the use of a flanking arrangement. In masonry works, the parapet rested on a solid band of horizontal masonry resting in turn on corbels or blocks solidly fixed into the scarp wall. The parapet wall was advanced a few inches beyond the face of the scarp leaving a space between the corbels for slanting loop holes in the horizontal band. The top of the parapet was also modified to allow fire at more distant points. In blockhouses the overhanging floor of the second story was also loop holed in a corresponding way. The balconies of houses could also sometimes be modified for such a purpose. Also called a machiolation or machiole.

MAGAZINE. A place for the storage of military supplies, more especially used in the sense of a powder magazine. Usually they were built of masonry, lined with wood with an air space left between the walls and off set vents for air circulation. In field works magazines were built of timber, often of round oak or chestnut logs, more than a foot in diameter. They were arranged vertically in close contact on a 2 inch plank 2 feet below the floor level, so ... to become the sides of the magazine. Another 2 inch plank was spiked to the top. Foot-thick logs were used for the roof timbers, which projected 6 inches beyond the walls on either side. Over the top of this, a waterproof layer of boards was buried under 10 feet of earth.

MAGISTRAL LINE. A line formed by tracing the line of the scarp's cordon around the fort, the base line from which the other parts of a permanent fortification were laid out.

MAIN GATEWAY. The principal entrance to a fortified work, usually wide enough for wagons and often arched over.

MANTLET. A movable parapet made of strong planks about 4 feet long, 3 feet wide and mounted upon two wheels. It served as a shelter for sappers.

MARTELLO TOWER. A small round tower or fort on the seacoast to guard against hostile ships. Usually it mounted several cannon. A typical Martello tower was 30 feet or so high and about the same diameter at the top, with two stories. The lower part contained store rooms and a powder magazine while the top was reserved for troops. The upper story was covered by bomb proof arches with as much as 5 feet of masonry over their crowns. A 6 foot parapet with a banquette surrounded the terrace above to protect the guns mounted there. Often a machicoulis hung out over the single ground level entrance so that defending troops could fire or drop grenades down on the attackers. Martello towers were named for a small tower on Martello Bay, Corsica, which repulsed British ships in a famous engagement of 1794.

MASK. Anything that hid a battery or work or shielded it from fire.

MERLON. The section of a parapet running between embrasures, usually 15 to 18 feet long.

MINE. An underground excavation for placing a powder charge intended to destroy a portion of a work.

MORRO CASTLE, EL MORRO. Any of several fortifications such as those of San Juan, Puerto Rico, Santiago de Cuba, or Havana, Cuba, dating between the Sixteenth and Eighteenth Centuries. Generally triangular in form, these works are built upon a headland (morro) overlooking a channel or entrance to a harbor. Usually these forts have embrasures in exposed walls facing the channel, while the front facing the land side resembles a hornwork, is ditched and furnished with a covered way and glacis. These works belong to the Italian School.

OCTAGON. An eight sided fortification.

ONDECAGON. An eleven sided work.

ORILLION. A rounded section of bastion at the shoulder serving to cover the retired and lower flank from oblique fire.

ORTHOGRAPHY. A drawing of the vertical characteristics of a work.

OUTWORKS. Subordinate parts of a fortification constructed between the glacis and the enceinte, but separated from the latter by a ditch.

PALISADE. A picket work consisting of 9 or 10 foot posts about 6 or 8 inches in diameter, sharpened on the top in pyramidal form and planted about 3 feet in the earth at least 6 inches apart. These stakes were often bound together at the base by a lintel, and were sometimes fastened to each other near the top by a riband of thick planks.

PANCOUPE (OR PAN COUPE). A short side on a fortification formed by cutting off the apex of a salient.

PARALLEL. In sieges, a line of entrenchment or covered road parallel with the enceinte of the besieged work and serving to guard the trenches. Originally parallels seem to have been 10 to 12 feet broad, later 15 to 18. There were usually three, one at 600 yards from the work under attack, another at 320, and the third near the glacis. Vauban devised them.

PARAPET. In permanent fortifications, a smaller earthen embankment or masonry

barrier along the forward edge of the rampart which afforded protection to the troops and guns posted behind it. In field fortification, it was the principal embankment protecting the defenders.

PARADOS. A traverse designed to protect the interior of a fortification from reverse fire.

PAS DE SOURIS. See stairs.

PLACE. A fortified town.

PLACE OF ARMS. An angle in the trace of the covered way, either salient or re-entering. Salient places of arms could be found across the ditch from each salient angle of a bastion or demilune, re-entering places of arms at the shoulders of ravelins or demilunes. From these places, defenders could launch a sally. In siege works, a parallel was sometimes referred to as a place of arms.

PLATFORM. A floor of strong planks laid upon joists or sleepers, and usually rectangular, upon which guns or mortars might be placed, also the level earthen base for this floor.

PLONGEE. In embrasures, the slope of the sole or bottom.

PETARD. A type of gun resembling a brass pot which was fastened to a strong square plank with an iron hook to fix it against a gate or palisade in order to break it down.

PORTCULLIS. A falling gate often mounted in the main gateway as a precaution against surprise attack.

POSTERN. A passageway under the terreplein leading from the parade to the fort ditch; it was generally closed by strong doors. Sometimes it was called a sally port.

PRIEST-CAP OR SWALLOWTAIL. In field fortification, a redan-like work with two salient angles.

PROFILE. A vertical section through a fortification.

RAMPART. An embankment or heavy masonry wall surmounted by a parapet and forming a part of the enceinte of a fort.

RAVELIN. An outwork, or work constructed beyond the main ditch, consisting of two ramparts forming a salient angle, and one or two demigorges formed by the counterscarp. It was separated from the covered way by its own ditch, which connected with the main ditch.

REDAN. A field fortification having two parapets forming a salient angle.

REDOUBT. In permanent fortification, a small work within a ravelin and of the same outline, also a square fort without bastions at some distance from the main fortifications. In field works, it was an enclosed work without re-entering angles, an unbastioned fort.

RE-ENTERINGS. Those angles formed by the junction of the faces and flanks or flanks and curtains which have the apex pointing inward.

RELIEF. Height of the interior crest of a rampart or parapet above the bottom of the ditch.

RETIRED FLANK. Whenever the flank of a bastion was drawn back so as to be covered against enfilade by the shoulder of the bastion it was said to be retired. See orillion.

REVETMENT. A barrier to retain earth in a vertical or near vertical slope. They were

made of masonry in permanent works and of planks, gabions, sods, posts, facines or sandbags in field fortifications.

RICOCHET FIRE. A technique involving loading guns with light charges and elevating them 10 or 12 degrees so as to send the shot over the parapet and bounce it along the rampart.

SALIENT. The angle at the projecting point of a bastion, ravelin, redan or other fortification.

SALIENT BASTION. In polygonal fortification, the bastion or bastionet at the junction of two faces.

SALLY PORT. A narrow entrance leading from the terreplein or banquette of the re-entering place of arms to the glacis. Also, a postern was sometimes called a sally port, but the name has often been misapplied to the main gate of a fortification.

SAP ROLLER. In sieges, a roller made of two large concentric gabions 6 feet in length; the outer one 4 feet in diameter, the inner one 2 feet, 8 inches. The intervening space was filled up with pickets of wood so make them musket proof. The roller was used to protect the sappers when they were at work.

SAPS. In sieges, a sap was a trench by which the attackers could move closer to a hostile fortification. Saps were usually dug in zig zag patterns to prevent the enemy from raking them so effectively with his guns. See double sap & flying sap.

SAUCISSON. Either a long fuse of cloth or leather filled with powder for firing a mine or a very long fascine used in the erection of batteries and repair of breaches.

SCARP. A retaining wall for the rampart that also served to make escalade very difficult.

SEACOAST FRONT (OR MARITIME FRONT). A front designed chiefly for defense against ships. Usually such fronts were casemented but had scarp walls exposed to direct fire.

SEACOAST GUN CARRIAGE. A type of carriage having the barrel or tube on a top carriage which was in turn mounted on rails along which it could recoil. The rails or chassis pivoted on a pintle to allow easy traversing of the piece from side to side. This type of carriage, a part of the French Gribeauval System, was first introduced into the United States in the 1790's.

SECOND COVERED WAY. A covered way beyond the second ditch.

SECOND DITCH. A ditch, usually flooded, located beyond the glacis.

SECTOR OF FIRE. An arc covered by the fire of a gun.

SECTOR WITHOUT FIRE. The blind area in front of a salient angle.

SHOT. A cannon ball. Siege guns usually fired shot weighing from 18 to 42 pounds. Shot served to smash enemy gun carriages and breach fort walls.

SHOULDER ANGLE. In polygonal fortification, the angle formed by the junction of a face and flank.

SHOULDER BASTION. In polygonal fortification, a bastion or bastionet at the intersection of a face and a flank.

SHOULDER OF A BASTION. The junction between the face of a bastion and its

adjacent flank was said to form its shoulder.

SIEGE. A regular attack on a fortified position by means of investment and approches.

SIEGE AND GARRISON CARRIAGE. A heavy two wheeled carriage for mounting siege or garrison guns. This carriage, like a field carriage, rested on its wheels and trail when in battery, its trail being raised and secured to a two wheeled limber for movement. It was, however, much more massive in construction.

SOLE. The bottom of an embrasure.

SORTIE OR SALLY. A sudden attack by a portion of the besieged garrison on the enemy and his siege works.

STAIRS. Steps of masonry were often made at the gorges of works and at the salient and re-entering angles of the counterscarp.

STAR FORT. A fort formed by joining equal sized salients around a circular figure. Such a fort had alternate salient and re-entering angles. This type of fort should not be confused with pentagonal, bastioned works.

STOCKADE. Either a palisade of tree trunks or a small picket work made from tree trunks 9 to 12 inches in diameter and about 12 feet long. This defense was often used to close the gorge of a redan or lunette so as to make it more secure against infantry.

SUNKEN BATTERY. A battery made by excavating the interior about 3 feet deep and erecting a low parapet from it in front. Sunken batteries took only half as much work as elevated batteries.

SUPERIOR SLOPE. The top of a parapet.

TABLETTE. The flat coping stone that surmounted the top of the scarp.

TALUS. The forward slope of a parapet, or the rampart slope.

TAMBOUR. A loop holed stockade or timber wall with two faces, made to cover the gorge of a bastion or an entrance.

TENNAILE, THE. Not to be confused with the tenaile trace, this was a low fortification erected between bastions in the ditches of some works. It served to mask the curtain from fire, but could be swept by fire from the the curtain and bastions if it were taken.

TENNAILE TRACE. Works using this trace were similiar to star forts except that the salients were of unequal size, usually large and small alternately.

TENAILLIONS. Works on either side of the ravelin with both faces parallel or almost parallel to the ravelin's faces.

TERREPLEIN. The earthen platform on top of the rampart that allowed for the movement of the defenders around the rampart and gun position. Originally the word seems to have been used for the area between the rampart and ditch in outworks.

TERRE PARADE PLEIN. The interior level space within the parapets of a field fortification, and shielded by them.

TOTTEN EMBRASURE. The final American form of casemate embrasure fitted with iron shutters for protection against grape shot. General Joseph G. Totten developed it. Unlike European embrasures opening in a uniform flare of 30 degrees and exposing 50 or more square feet, American embrasures flared both to the inside and outside

thus reducing the exposed area to 12 square feet and allowing twice the traverse. The final stepped form of embrasure limited the external opening to 3.9 square feet. Iron shutters added even more protection.

TOWER BASTION. A casemated masonry bastion Vauban used behind the detached bastions in some of his works. Also see bastionet.

TRACE. The outline figure or plan of a permanent or field fortification or line of entrenchments. The principal traces were bastioned, star, tennaille, cremaillere or indented line and polygonal.

TRAVERSE. A low mound perpendicular to and partially across the covered way, so as to prevent enfilading fire by attackers who have reached the edge of the ditch at some point. Traverses were especially important in protecting the re-entering places of arms. Also, the term applied to a similiar mound erected to protect gun positions in a work from enfilading fire, or, to partially close the entrance of a work or the gorge of a bastion.

TRAVERSE CIRCLE. A circular or semicircular track upon which a seacoast carriage revolved on its pintle.

TRAVERSE PLATFORM. See seacoast carriage, traverse circle.

TROUS-DE-LOUP, OR TRAP HOLES. Rows of pits, either conical or pyramid shaped, with a stong stake in the center of each. The pits were used as an obstacle against cavalry and were either 2½ or 8 feet deep so that they would be useless as cover. Each hole was usually 6 feet in diameter at the top and 18 inches at the bottom.

TRUCK CARRIAGE. A low garrison or naval gun carriage made of two wooden sides in which the barrel rested. The sides or brackets were joined by a transom and front and rear axels. the carriage had four small trucks or wheels. During the Seventeenth, Eighteenth and early Nineteenth Centuries such carriages were sometimes used in forts or taken from ships to use in a siege.

WORK. A fortification of some kind.

ZIG ZAGS. See saps.

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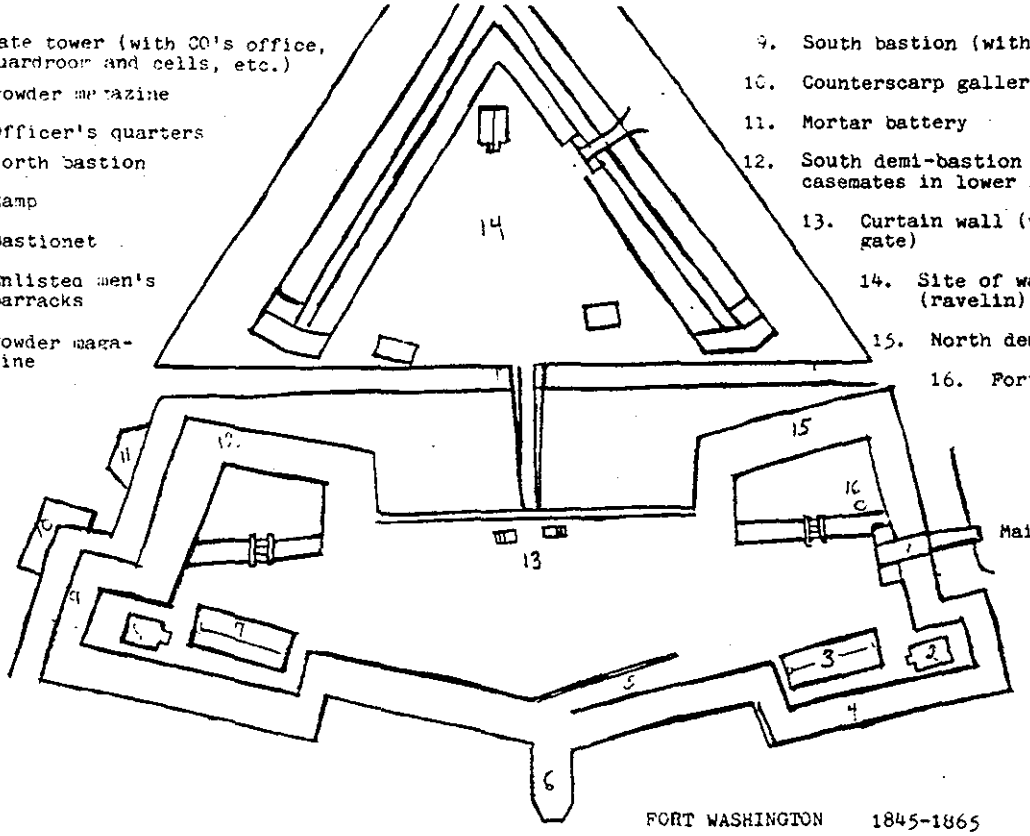
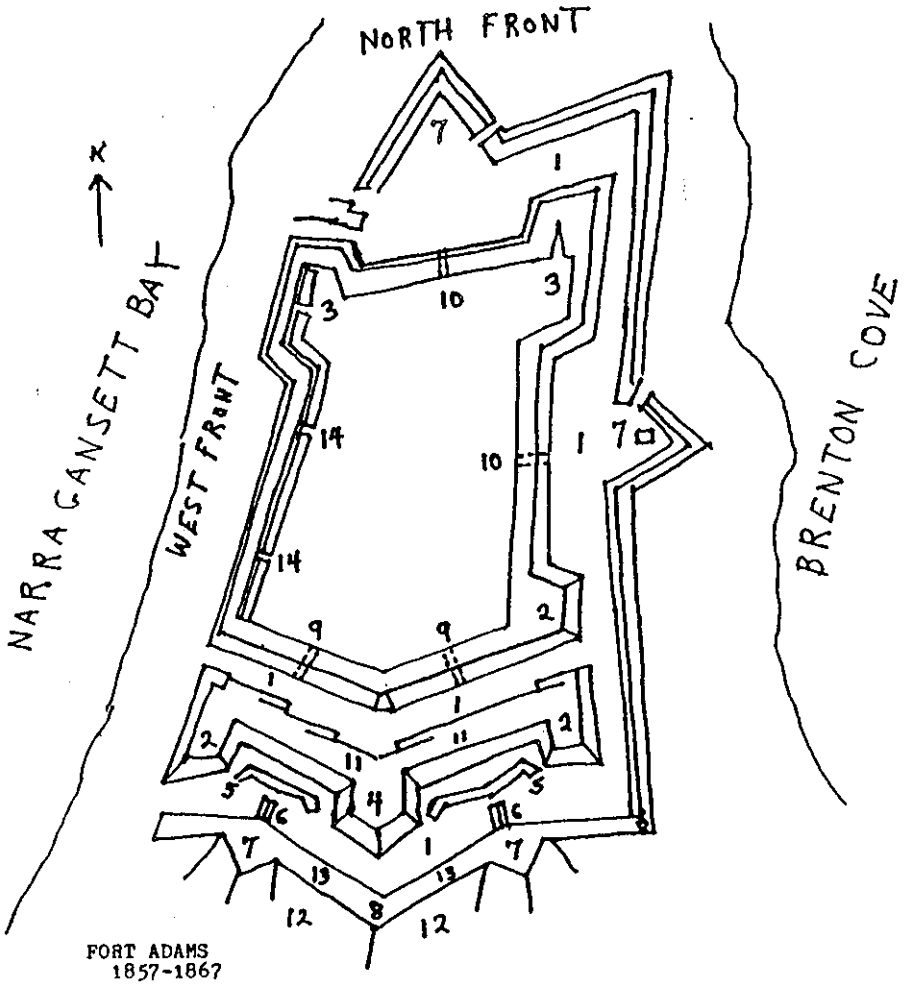
1. Gate tower (with CO's office, guardroom and cells, etc.)
2. Powder magazine
3. Officer's quarters
4. North bastion
5. Ramp
6. Bastionet
7. Enlisted men's barracks
8. Powder magazine
9. South bastion (with postern)
10. Counterscarp gallery
11. Mortar battery
12. South demi-bastion (with casemates in lower level)
13. Curtain wall (with water gate)
14. Site of water battery (ravelin)
15. North demi-bastion
16. Fort's well




FORT WASHINGTON 1845-1865




FORT ADAMS
1857-1867

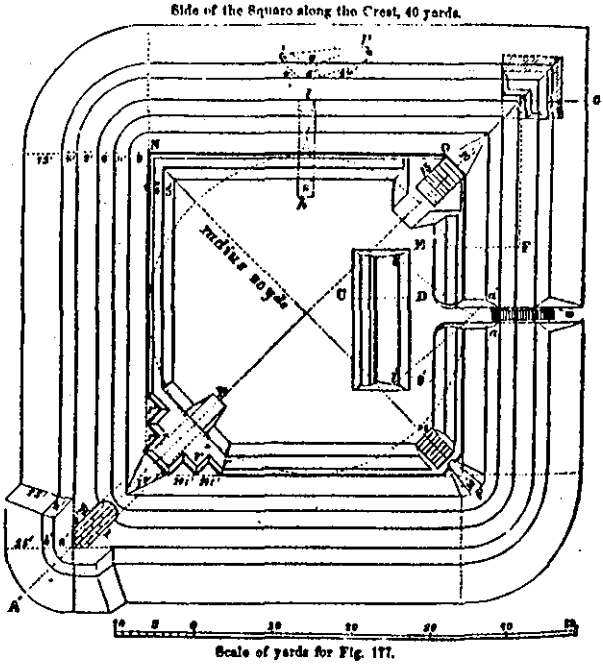
1. Ditches
2. Demibastions
3. Hollow bastions
4. Full bastions
5. Tennailes
6. Caponiers
7. Reentering places of arms
8. Salient places of arms
9. Posterns
10. Gates
11. Crownwork w r. f. gallery
12. Glacis
13. Covered way (above counterscarp gallery)
14. Bridges to second tier casemates


FORT NIAGARA
1759-1863

1. Six Nations Gate
2. Redoubts or keeps (c 1767)
3. Demibastio.. (1756)
4. Ravelin or Demilune
5. House of Peace (1726)
6. Lunettes with redoubts
7. Salient place or arms
8. Traverses on covered way
9. Main ditch
10. Front facing river
11. Curtain with postern
12. Glacis
13. River gate
14. Front facing lake
(now destroyed)

FIG. 117.

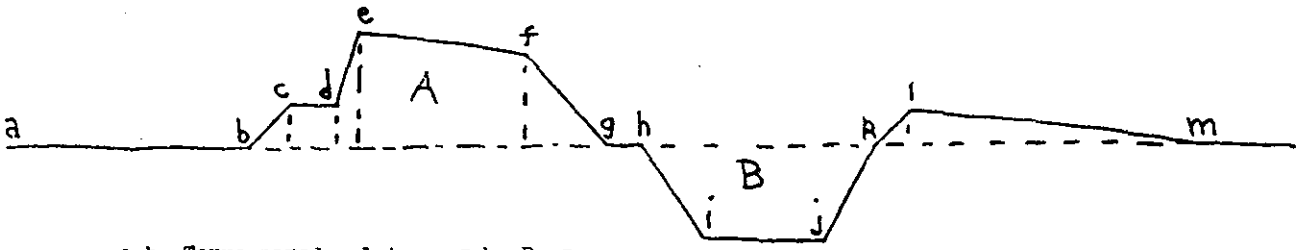
Side of the Square along the Crest, 40 yards.




Small redoubt for four guns and 120 men and measuring 40 yards on a side.

Scott, Military Dictionary, p. 498

# FIELD FORTIFICATION PROFILE

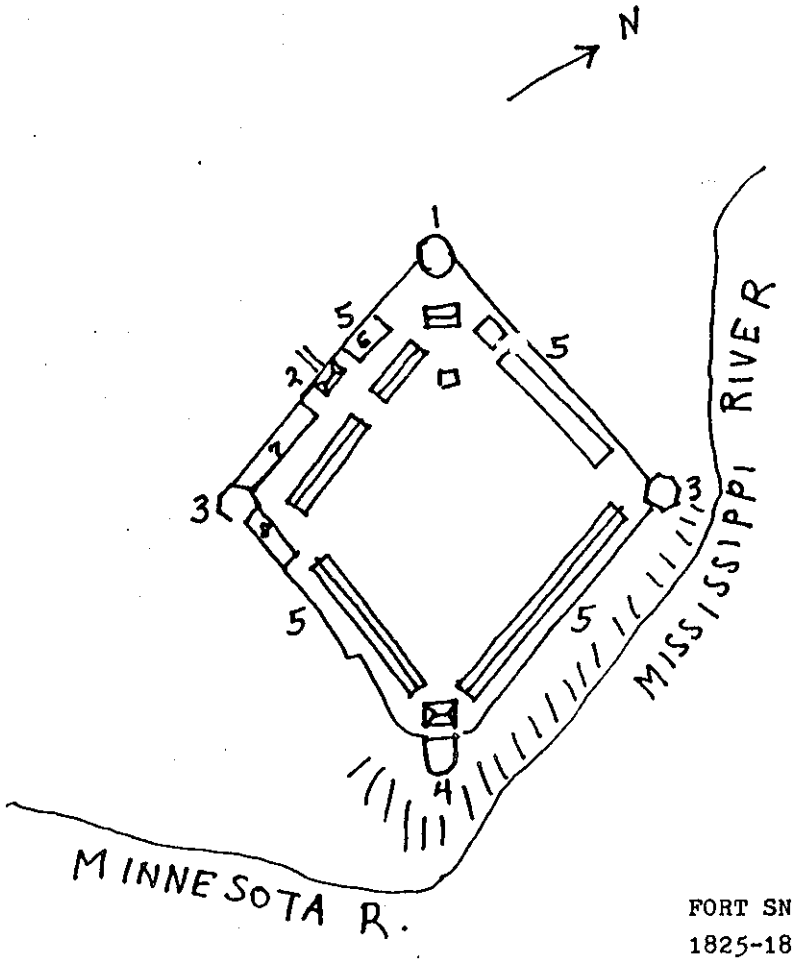



| | | | |
|---|---|---|---|
| a-b | Terre parade plein | g-h | Beam |
| b-c | Banquette slope | h-i | Scarp |
| c-d | Banquette tread | j-k | Counterscarp |
| d-e | Interior slope | l-m | Glacis |
| e-f | Superior slope | e | Interior crest |
| f-g | Exterior slope | f | Exterior crest |

A Parapet

B Ditch

a-m Plane of site




FORT SNELLING
1825-1835

1. Round tower
2. Gate house
3. Angular towers
4. Battery
5. Curtains
6. Guard house
7. Shops
8. Hospital